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ERRATA.

P. 55, at top, for: see *la*, read, see *lb*. P. 55, midway, for: continuity of the mandibles with the labral sclerite. When present—, read, continuity of these processes with the labral sclerite. When the mandibles are present—. P. 64, midway, for: *pulchrissimns*, read, *pulcherrimus*. P. 131, midway, second paragraph, for: *widening*, read, *winding*.

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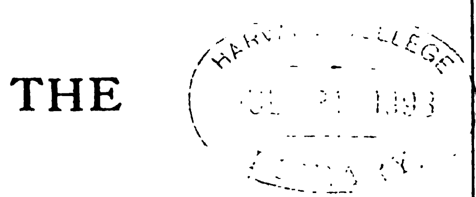
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KANSAS UNIVERSITY QUARTERLY.

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Revision of the Genera Dolichopus and Hygroceleuthus.

BY J. M. ALDRICH.

(With Plate I.)

The two genera discussed in the present paper are readily separated from all other North American Dolichopodidæ by the presence of two distinctive characters,—the hind metatarsus with one or more bristles above, and the first antennal joint hairy above. In order to distinguish them from some related foreign genera, it is necessary to add only one other peculiarity,—the antennal arista is always bare or pubescent, never plumose.

DOLICHOPUS Latreille.

Of the group so limited, nearly all the numerous species belong to *Dolichopus*; under the head of *Hygroceleuthus* will be found a statement of the characters belonging especially to the latter genus; see also Loew's Monograph.

The following descriptions bring up the total number of North American species of *Dolichopus* to eighty-one, of which only forty-seven are found in Loew's Monograph. Of the remainder, five were described later by Loew in his seventh Century; Osten Sacken described three in his Western Diptera and one (*myosota*) in Biologia Centrali-Americana, Diptera I, 213; Wheeler published four (*incongruus*, *flagellitenens*, *henshawi*, *germanus*) in Psyche, May, 1890, p. 337; and twenty-one are described in the following pages. The bibliographical references omitted here are found in Osten Sacken's catalogue.

The acquisition of such a large number of species since Loew's time has only served to emphasize the correctness of his views on the geographical distribution of the genus. It belongs distinctly to the

north temperate zone, and seems scarcely to reach the southern border of the United States; the only species of true *Dolichopus* known by me to occur farther south are *myosota* in North Sonora, near the Arizona line, and an undescribed species, mentioned by Osten Sacken in the same connection, from Durango; but the latter is known to be Alpine (8100 ft.) I have examined large collections of West Indian and South American material without finding the genus.

I am indebted to the University of Kansas for the opportunity to work up her excellent collection (indicated in the article by U. K.); to Dr. Williston for books and other assistance; to C. W. Johnson, D. W. Coquillett, and others for material contributed.

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Dolichopus johnsoni, n. sp.

Legs and cilia of orbit and tegulæ black; wings infuscated.

Face narrow, with yellowish pollen; front green. Antennæ black, third joint rounded. Thorax shining green, rather dark; pleuræ, black. Tegulæ and halteres yellow. Abdomen dark blue-green, posterior margins of segments blackish. Lamellæ of hypopygium white with brown border and bristles. Coxæ black, yellow tipped, the front ones white dusted. Femora black, knees yellow; anterior tibiæ yellow, hind ones black. Anterior tarsi yellow, infuscated toward the tip; hind ones black. Fore tarsi simple. Hind tibiæ a little thickened. Wings narrowed toward the base, the outer two-thirds strongly infuscated, the smokiness fading away gradually toward the root.

Length, 3.2 mm.; of wing, 3 mm.

One male, Jamesburg, N. J., July 4, '91 (C. W. Johnson).

Dolichopus corax Osten Sacken.

One female, California (U. K.), agreeing with Osten Sacken's description, but 4.5 mm. long. The fore coxæ have a thin silvery dust, and but little hair except on the lower and outer edge, where there are a few bristles; hind tibiæ with a row of about six strong bristles uniformly placed on the hind side, also a row of delicate ones on the front side.

This is the only species known that has black femora and enlarged fore tarsi in the male.

Dolichopus laticornis Loew.

Two males, no locality (U. K.).

In one specimen the tegulæ have pure light yellow cilia; in the other, black ones with only a slight admixture of pale. The yellow of the middle femora is more extended than the description states, leaving, in the one case the basal half, in the other a mere basal ring, black. Middle tibiæ yellow. I should consider the hind tibiæ thickened. The convergence of the third and fourth veins is very slight.

A female from Conn. (U. K.), related to this species, has mixed tegular cilia, hind tibiæ nearly all black, wings infuscated along the veins, and minor differences.

Dolichopus gratus Loew.

A single male, White Mts., Aug. (U. K.). The hind femora are ciliated the whole length, longest in the middle; in the other species with black femora, as far as known, the cilia are on the apical half.

The middle femora also have cilia, shorter and more delicate, throughout their length. The hind tibiæ are red only on the basal third.

A female from Florida (Johnson) has black femora, tegular and orbital cilia, and antennæ. The pleuræ and sides of abdomen are noticeably silvery dusted, and the face also is silvery. It evidently represents a new species of the foregoing group, but it would be difficult to prepare from a female a description from which the male could be recognized.

Dolichopus calcaratus, n. sp.

Differs from *gratus* Lw. in the following respects: hind tibiæ wholly black; veins of wing black instead of yellow; fore coxæ even more densely hairy and bristly.

One male, Dover, N. J., June 18 (C. W. Johnson). An examination of more material may yet show that in this case these characters are not of specific value.

Dolichopus detersus Loew.

Two males and one female, St. Anthony Park, Minn. (Lugger); one female, Brookings, S. D., June 19.

Loew's brief Latin description may be supplemented as follows: Third joint of antennæ rounded, rather small; thorax rather high and prominent in front; hypopygium black, lamellæ small, oval, dirty whitish, part of the hairs yellow; anterior tarsi slightly longer than the tibiæ.

Female. Face wide, thinly dusted above, thickly below, silvery; hind femora not ciliated, hind tibiæ and the costa not thickened.

Dolichopus kansensis, n. sp.

Dark green, feet black, cilia of inferior orbit white, face wide.

Face and lower part of front yellow pollinose, remainder of front dark green. Antennæ black, the third joint only moderately large, with a short arista. Dorsum of thorax dark green, pleuræ black with but little dust. Tegulæ yellow with black cilia, halteres yellow. Abdomen dark green, toward the tip more black-green. Hypopygium black, the lamellæ rounded, whitish, with a rather wide black border and small bristles. Legs from coxæ to tarsi wholly black, at the knees with the faintest trace of red. Fore tarsi over 1½ times the length of the tibia, middle tarsi about 1¼ times. Hind tibiæ incrassated; hind femora below with delicate blackish cilia of moderate length. Wings almost hyaline; costa slightly thickened; last segment of fourth vein as in the figure of *Hygroceleuthus ciliatus*.

Length, 4.2 mm.; of wing, 3.8.

One male, Kansas (U. K.).

Resembles *D. ovatus*, but has wider face, shorter and weaker cilia of hind femora, and fore tarsi nearly twice as long.

Dolichopus ovatus Loew.

A puzzling species. A male from California (U. K.) may belong to it, but the tibiae are wholly black. From Loew's description it would seem that this is not a great discrepancy. The wings of the specimen in question are narrowed at the base.

I also doubtfully identify a female from Philadelphia (Aug. 7, Johnson) and one from Brookings, South Dakota, with this species.

Dolichopus albiciliatus Loew.

Wheeler, Psyche, May, 1890, p. 338 (male).

A female, Dover, N. J., June 23 (Johnson), agrees well with the description except that the wings are brown along the veins to some extent. Another female, no locality, (K. U.), has hyaline wings and agrees well.

Dolichopus convergens, n. sp.

Male. Dark green, cilia of inferior orbit white, femora black, hind tibiae black at tip, third and fourth veins of wing convergent at the tip.

Face narrow, silvery white; front green, not very shining; antennae black, third jointed rounded, rather large; thorax dark green, shining; pleurae black, a little dusted; tegulae yellow, with black cilia; halteres yellow; abdomen dark shining green, not compressed; hypopygium black, its lamellae of moderate length, truncate in front, rather deeply jagged, with the usual black border. Coxae and femora black, trochanters and knees yellow. Fore and middle coxae with a few bristles, and a little black hair and silvery dust on the fore side. Tibiae yellow, the hind ones black on the last fourth and slightly incrassate. Hind tarsi wholly black, anterior ones blackened from the tip of the first joint. Each tibia is about as long as the first three joints of its tarsus. Wings hyaline, narrowed basally; the third and fourth veins converge, and end considerably before the apex, about one third as far apart as the second and third.

Length 4 mm.; of wing, 3.8 mm.

Four males, Mt. Hood, Oregon, and one, Washington.

This species may be distinguished from *albiciliatus* and *xanthocnemus* by the absence of cilia on the hind femora of the male.

Dolichopus pachycnemus Loew.

Seven males and four females, Brookings, S. D. Two bear dates of capture, June 12 and 16. A well marked species, agreeing with description.

Dolichopus brevipennis Meigen.

Four males, Skaane, Sweden, (Henry G. Klages). I have not seen it from North America.

Dolichopus albicoxa, n. sp.

Male. Cilia of inferior orbit and of tegulae pale, antennae black, first joint largely red below, hind tibiae black at tip.

Face of moderate width, white; front shining green; third joint of antennae rather large. Thorax green, very shining; pleurae green, white-dusted. Abdomen green, toward the tip coppery. Lamellae of hypopygium white on the basal half, the rest with a brownish tinge, from the black hairs inside, which show through; border blackish, with the bristles confined to the apex. Legs yellow, fore coxae with considerable white pollen, and some microscopic white hairs, but no black hairs or bristles except about six at the end; in certain directions these coxae appear almost white; middle and hind coxae black, broadly yellow at tip. Hind femora not ciliated. Last fourth or fifth of hind tibiae black, as also the whole hind tarsi. Fore tarsi one and one-half times as long as the tibiae; first three joints slender, stalk-like; fourth very short, black, compressed; last joint longer, oval, also compressed and black, the claws attached before the extremity. Wings slightly yellow, costa scarcely thickened.

Length, 5 mm.; of wing, 4 mm.

Two males, Massachusetts and Connecticut (U. K.). The female will probably be distinguished from that of *brevimanus* and *socius* by having fore tarsi longer than the tibiae.

Dolichopus longimanus Loew.

Three females, two from Hanover, N. H. (Weed), one from Custer, S. D., are readily distinguished by the dark color of the basal half of the fore coxæ.

Dolichopus brevimanus Loew.

Two female specimens, Massachusetts and Connecticut (U. K.), may belong to this species; but the differences among the females of this and several other species of the group are so slight that no positive conclusion can be arrived at without a larger amount of material.

Dolichopus socius Loew,

One male, Massachusetts (U. K.), is 3.5 mm. long, but otherwise agrees well with the description.

Dolichopus palæstricus Loew.

One male, Dover, N. J., June 18 (C. W. Johnson).

Dolichopus splendidus Loew.

Numerous specimens, Brooking, S. D., and four from Michigan; June 3, 10, 12, 15. The female Loew mentions in connection with this species undoubtedly belongs to it, as several of mine have the tip of the hind tibia with a trace of brown. One of the commonest northern species.

Dolochopus dakotensis, n. sp.

Cilia of inferior orbit and tegulae pale, antennæ black, posterior tarsi yellow to a considerable extent, male fore tarsi with three joints enlarged, the third and fourth white.

Male. Face narrow, yellow; antennæ wholly black; front green; thorax green, moderately shining; pleurae green, rather thickly dusted. Abdomen green, shining, the first segment on each side with a few long, pale hairs; lamellæ of hypopygium rounded, whitish, narrowly margined, jagged, and with black bristles. Fore coxae yellow, near the apex with a few black hairs and bristles, the remainder of the surface in front with a few microscopic white hairs, otherwise bare. Middle and hind coxæ black with yellow tips. Femora, tibiæ and proximal half of tarsi all yellow; hind femora with short, sparse, and delicate whitish cilia beneath; hind femora with the usual bristles behind, and a row of hairs down the front side; on the inner side below with a cluster of hairs. Fore tarsi double the length of the tibiæ; the figure gives a good idea of the structure, but does not bring out the third joint white enough. The outer side of the fifth joint has a satiny reflection. Wings hyaline, with yellow veins; costa thickened for a considerable distance before and beyond the first vein.

Female. Face wider; fore coxæ with delicate, sparse, black hairs on fore side; fore tarsi one and one-third times the length of the tibiæ, the infuscation perceptible from the tip of the first joint in all the tarsi.

Length, 5.5 mm.; of wing, 5.1 mm.

Twelve males and one female, Brookings, S. D. Several were captured on June 16.

Dolichopus edactylus Loew.

A male and a female, Douglas Co., Kans. (U. K.), June 17 and 24. The female has the tegular cilia mixed with black, particularly on one side.

Dolichopus variabilis Loew.

Four males and four females; Mass. (U. K.), Pa. and N. J. (Johnson), Custer, S. D.; June 27, July 1, August 4, 7, 14, 20. The hind tarsi vary in color as mentioned by Loew.

Dolichopus bifractus Loew.

Iowa (Osborn); Ohio and New Hampshire (Weed); Lawrence, Kansas; Brookings and Custer, S. D.; Fargo, N. D. Sixty specimens. This is perhaps the commonest Dolichopus throughout the northern states. The opaque thorax, red antennæ, and broken fourth vein render a wrong identification very unlikely, even to a beginner.

Dolichopus ramifer Loew.

Nineteen specimens, both sexes; Douglas Co., Kans. (U. K.), Brookings, S. D., Mich., Ames, Ia. (Osborn), Montana (Coquillett). Very easy to recognize in either sex. In Loew's diagnosis the cilia of the tegulæ are said to be yellowish, which is a misprint. In three other places he calls them black.

Dolichopus reflectus, n. sp.

Female. Antennæ red; cilia of tegulæ black, of inferior orbit pale; fourth vein of wing broken, hind tarsi and tips of hind tibiæ black. Face white, above a little yellowish; front blue. Thorax green, considerably dusted with gray; a narrow central stripe and a wider lateral one bronze; pleuræ blackish-green, with white dust. Abdomen bronze-green, not very bright. Fore coxæ yellow, thickly clothed in front with minute black hairs. Posterior coxæ black, with yellow tips. Fore tarsi scarcely longer than their tibiæ, infuscated from the tip of the first joint. Hind tarsi wholly black; hind tibiæ bristly, black at tip. Wings with a brownish tinge; fourth vein broken, the upper angle appendiculate in one wing, and very slightly rounded in the other; the portion between the two angles runs in a slightly oblique direction, so as to make acute angles with the other portions.

Length, 5.2 mm.; of wing, 4.7 mm.

One female specimen, Philadelphia, May 30 (C. W. Johnson).

Dolichopus vittatus Loew.

One male, Brooking, S. D. The relation among the males of this and the two following species is exceedingly close; as for the females, I do not see any characters to separate the present species from *cuprinus*, although representatives of both are probably before me.

Dolichopus cuprinus Wiedemann.

Nineteen specimens. The male differs from *vittatus* in having the fore tarsi ornamented with black hair, and the hind femora ciliated; from *longipennis* in the length of the fore tarsi, the presence of cilia on the hind femora, and the wider wings. The species is of wide distribution, the specimens examined being from Mass., Pa., N. J., Ohio, Kansas and South Dakota.

Dolichopus longipennis Loew.

Numerous specimens; Kansas, Tenn., Ohio, Pa., N. C., Fla., Ga., N. J. These localities range a little farther south than those given for *cuprinus*. The width of the wing seems a little variable.

Dolichopus hastatus Loew.

A single female, Mt. Hood (U. K.). The coloring of the middle tibiae and tarsi is distinctive. The species was described from Sitka.

Dolichopus plumipes Scopoli.

Eleven specimens, Brookings, S. D.; one male, Manitou Park, Colorado, July (Snow).

Dolichopus flagellitenens Wheeler.

PSYCHE, May, 1890, p. 339.

Nine males and three females, Brookings, S. D., June 16. The female has the hind tibiae scarcely a third black, last three joints of fore tarsi black, and lacks the sexual marks which distinguish the male. A single female from North Park, Col. (U. K.), is not distinguishable from this species.

Dolichopus vigilans, n. sp.

Shining blue-green, antennae red, cilia of inferior orbit pale, of tegulae black, hind tibiae black at tip.

Male. Face yellow, front dark bluish green; antennae red, the apical half of third joint blackish. Thorax and abdomen shining bluish green, dusted with white along the sides; hypopygium rather small, the lamellae of the usual size, whitish, rounded, with the usual jagged black border and bristles. Fore coxae yellow, with rather numerous small black hairs on the front side, beginning at the base; middle and hind coxae blackish, the latter more yellowish toward the tip. Hind femora with small yellow cilia below, near the tip only. Middle tibiae with a few long, divergent bristles; hind tibiae a little enlarged with a glabrous stripe the whole length of the inner side and another behind, and tipped with black. Fore tarsi one and one-half times as long as the tibia, the first two joints slender, stalk-like, yellow; third joint slender, short, black at tip; fourth joint black, still shorter, compressed, with black hairs above; fifth joint longer than the fourth and wider, black, with black fringe above. The upper apical angle is acute, and the apical margins recede in a straight line to the claws. The empodium is modified into a snow-white little plume, fitting close to the fifth joint, and making it appear white at tip. A rather high power may be necessary to show the true condition.

Wings hyaline, fourth vein rather abruptly bent, costa with a small, short thickening at the apex of first vein.

Female. Face a little lighter yellow, and wider; fore tarsi blackened from the tip of the first joint; hind tibiae simple, costa not thickened.

Length, 5.2 mm.; of wing, 4.1 mm.

A male and a female, Douglas county, Kansas, June 24 and 29, (U. K.).

Dolichopus comatus Loew.

Five males and three females, New Jersey and Pennsylvania, May 30 to July 24 (C. W. Johnson). The first joint of the fore tarsi is, in both sexes, of nearly the same length as the remaining four. This is quite characteristic.

Dolichopus brunneus n. sp.

Female. Small, shining dark bronze species; antennae black, cilia of inferior orbit pale, of tegulae black, legs yellow.

Face broad, more so above, yellowish gray; front greenish bronze. Thorax dark bronze, moderately bright; pleurae gray pollinose; halteres and tegulae yellow. Abdomen slightly more bright than thorax. Legs yellow; posterior coxae black, fore coxae yellow, with a trace of infuscation at the base, on the fore side with minute black hairs. Fore and middle tarsi blackened from the tip of the first joint, about as long as their tarsi. Hind tarsi and tip of tibiae black. Wings narrow, slightly tinged with brown, the anal angle not prominent; costa with a slight, long enlargement.

Length, 3 mm.; of wing, 2.8 mm.

One female, Brookings, S. D., June 18. The smallest North American species.

Dolichopus incisuralis Loew.

In the neighborhood of this species I have a number of females from Connecticut, (U. K.), New Jersey and Pennsylvania (Johnson), Ohio (Weed), and California (Coquillett). Some of them may belong to *setosus*. Not having any males, the separation of the two species is practically impossible.

Dolichopus obcordatus, n. sp.

Antennae black, cilia of inferior orbit pale, of tegulae black; legs yellow, coxae and tip of hind tibiae black; fore tarsi of male with the last joint flattened, obcordate, deeply notched at the end.

Male. Face yellow pollinose, front shining yellow-bronze, green along the edges. Antennae moderately large, especially the third joint. Dorsum of thorax green, rather coppery; pleurae dark green,

with little dust. Abdomen green, coppery, the lamellae white, oval, with the usual dark margin, notches, and bristles. Coxae black, the fore ones a little lighter toward the tip. Hind femora ciliated with moderately long reddish or brownish hairs. Fore tarsi once and a half the length of the tibiae, the first three joints red, the last two black, compressed; middle tarsi black from the last third of the first joint; hind tarsi and last fourth of tibiae black. Wings hyaline, the first flexure of the fourth vein abrupt, in some cases minutely appendiculated, but usually a little rounded. Costa thickened very considerably, gradually diminishing toward the apex.

Female. Face whitish, fore tarsi plain, as long as the tibiae, blackened from the tip of the first joint; hind femora not ciliated.

Length, 4 mm.; of wing, the same.

Three males and four females, Wyoming (U. K.), Manitou Park, Col., July (Snow).

Dolichopus gracilis, n. sp.

Male; antennae wholly red, cilia of inferior orbit pale, of tegulae black, legs yellow, hind tarsi wholly black.

Face narrow, grayish yellow, more yellow toward the antennae; front green; antennae moderately long. Thorax greenish bronze, pleurae dark green, dusted with gray. Abdomen more pure green, the sides below whitish dusted, with yellow hair. Hypopygium black, the lamellae small, dirty whitish, rounded, deeply jagged, with the usual curved and branched bristles. Fore coxae light yellow, in front almost white, with microscopic, sparse white hairs. Middle and hind coxae blackish at base, toward the tip more yellowish. Hind femora with a scattered row of long pale cilia below; all tibiae yellow. Fore tarsi one and one-half times as long as the tibiae, blackened from the tip of the first joint; hind tarsi wholly black. Wings slghtly yellowish, costa scarcely thickened.

Length, 4 mm.; of wing, 4.1 mm.

A single male, Philadelphia, Pa., August 4 (C. W. Johnson).

Dolichopus angustatus, n. sp.

Male. Antennae black, first joint in part yellow, third joint very wide and long, with a sharp point; cilia of inferior orbit pale, of tegulae black, last joint of fore tarsus enlarged.

Face grayish yellow, front shining violet; first joint of antennae slender, arista inserted beyond the middle of third joint. Thorax bright bluish green, with a bronze stripe each side above the root of the wing, and a very narrow one in the middle; pleurae dark green, light dusted. Abdomen somewhat bluish green, more bronze before

the incisures. Hypopygium black, the lamellae whitish, rounded, with black margin, jagged near the apex, and curved black bristles. Fore coxae yellow, with small black hairs in front near the inner side, and some white dust; middle and hind coxae yellow, the former considerably, the latter slightly, brownish toward the base. Femora and tibiae yellow, the hind femora not ciliated. Fore tarsi nearly twice as long as the tibiae, not very slender; the first four joints plain, yellow; fifth joint as long as the third, black, flattened; fourth somewhat flattened, but not otherwise modified. Middle tarsi blackened from the tip of the first joint; hind tarsi wholly infuscated, still at the base not decidedly black; the color suggests that the specimen may be immature. Further material may show that the species properly belongs in the group with hind tarsi pale at base. Wings subhyaline, rounded at apex, the widest part beyond the middle, narrowed toward the base. Beyond the double flexure the fourth vein runs in a gentle curve parallel with the third vein, ending barely before the apex.

Length, 5 mm.; of wing, 4.2 mm.

A single male, Mass. (U. K.).

Dolichopus lobatus Loew.

Numerous males and females, Brookings, S. D.; two from Agricultural College, Mich.; June 14 and 16 are the dates of two specimens. An easily recognized species; the female has a few black hairs mixed with the yellow ones on the fore coxae, and lacks the lobes on the wing and other sexual characters; otherwise as the male.

Dolichopus agilis n. sp.

Antennae black, first joint yellow; cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi wholly black.

Male. Face yellowish gray; front shining green. Dorsum of thorax shining green; pleurae blackish green, with gray dust. Abdomen shining green; hypopygium black, at base somewhat green or bronze. Lamellae light yellow, twice as long as wide, the black border wide at tip, which is a little jagged and has two or three crooked black bristles; upper margin smooth, with short black hairs, changing to yellow near the base. Fore coxae yellow, with minute black hairs in front; middle and hind coxae black, tipped with yellow. Femora and tibiae yellow, plain. Fore tarsi almost once and a half the length of the tibiae; first three joints slender, stalk-like, yellow, second and third each more than half as long as the preceding; fourth joint very short, wider than long, black, a few long black hairs above; fifth joint as long as the second, wide, black, with fringe of appressed black hairs above. Empodium a little enlarged, forming a snow-white plume reaching up half the width of the fifth joint, so

that the latter appears to have a white tip. Middle tarsi gently infuscated from the tip of the first joint. Wings with a grayish tinge, the fourth vein running rather far forward at its tip, costa not thickened.

Female. Fore tarsi gradually infuscated from the tip of the first joint, one and one-third times as long as the tibiae; otherwise, after allowing for the sexual characters, the same as the male.

Length, 5 mm.; of wing 4.5 mm.

One male, two females, Colorado (U. K.)

Dolichopus marginatus, n. sp.

Antennae red, third joint largely black or brown; cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi entirely black.

Male. Face whitish, moderately narrow; front with a violet reflection; black hairs of first joint of antenna rather large and abundant. Thorax dark green, shining; pleerae blackish-green, scarcely dusted. Abdomen shining dark-green; hypopygium black, lamellae large, roundish, white, with a wide black margin, sharply defined; at the apex the crooked branched bristles are as usual, but from this point on around the upper edge, instead of the usual row of short and rather scattered bristles, is a row of very long, strong, nearly straight ones. They are black and curve gently toward the middle plane of the body. Near the apex they arise from a series of prominences which become gradually smaller. Fore coxae red with black hairs on the front side; middle and hind coxae black, both, especially the latter, considerably yellowish toward the tip. Femora and tibiae yellow; hind femora ciliated below on the apical half with a row of long, black hairs (the only instance I know in the genus where yellow femora have black cilia). Hind tibiae slightly infuscated at the apex, with a dark line on the inner side of the basal half, and the hind side wholly glabrous.

Fore tarsi slightly longer than the tibiae, infuscated from tip of first, blackened from the middle of the third joint; the fifth joint is as long as the fourth and has a slight projection above the claws, yet could scarcely be called flattened or enlarged. Middle tarsi gradually infuscated from the tip of first joint; hind tarsi wholly black. Wings rather broad and short, with a slight grayish tinge; costa with a slight, short thickening.

Female. Fore tarsi as in the male; except the usual sexual characters, not differing from the male.

Length, 5.5—6 mm.; of wing 4.2—4.5 mm.

Two males, eight females, Connecticut (U. K.). The color of the legs is more reddish than usual.

Dolichopus scoparius Loew.

Two males and a female, Dover, N. J., June 23; Philadelphia, July 14 (Johnson); Mass. (U. K.). Wheeler (Psyche, May, 1890, p. 339) has described the very peculiar male lamellae. In my best preserved male the face is decidedly grayish yellow, and not at all white except at the lower border.

Dolichopus duplicatus, n. sp.

Male; antennae red, third joint black; cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi yellow at base.

Face light yellow, rather wide; front green, opaque, with yellow dust. Thorax green, thickly dusted with yellow except in the neighborhood of the scutellum; brown stripes above root of wings distinct; pleurae blackish green, moderately dusted. Abdomen green, coppery, the sides a little light-dusted. Hypopygium dusted, opaque, shining black only at tip. Lamellae very large, yellow, the outer margin excised so as to leave an apical and an upper lobe; the apical margin in my only specimen is somewhat folded in and difficult to examine; it appears, however, not to have any strong bristles nor black border, but only a fringe of short hairs. Fore coxae yellow with black hairs on the front side; middle and hind coxae black, with yellow tips. Femora and tibiae yellow; hind femora not ciliated, hind tibiae plain. Fore tarsi one and one-half times the length of the tibiae, the first two joints slender and stalk-like, yellow; third joint also slender, blackish; fourth joint triangular, black, with a border of long black hairs above; fifth joint twice as long as the fourth, compressed, over half as wide as long, oval, projecting beyond the claws a little, black, with a black fringe above. Middle and hind tarsi gradually infuscated from the tip of the first joint.

Wings nearly hyaline, broad, the margin deeply notched at the fifth vein; costa scarcely thickened.

Length, 6 mm.; of wing, 5.5 mm.

One male, State of Washington (U. K.).

Dolichopus plumosus, n. sp.

Male; antennae red, third joint black; cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi at base yellow.

Face uniform pure yellow; front shining green. Thorax green, moderately shining; pleurae blackish-green, light-dusted. Abdomen bright green; hypopygium small, shining green or bronze at base, black at tip; lamellae pale yellow, elongated, broadly black-margined at apex, where they are also jagged, with curved and branched black bristles. Along the upper margin the black border grows narrower, and the bristles are small. Fore coxae yellow, with both yellow and black

hairs on the front side. Middle and hind coxae black with yellow tip; hind femora not ciliated, hind tibiae thickened in the middle, not glabrous. Fore tarsi over 1½ times the length of the tibiae; first two joints yellow, slender; third joint slender, brown; fourth joint short, black, enlarged, fringed above, obliquely truncate at tip; fifth joint longer than fourth, black, fringed above, compressed; the empodium forms a large, snow-white plume, lying just at the end of the fifth segment and apparently forming a part of it. Middle and hind tarsi infuscated from the tip of the first joint. Wings hyaline, of uniform width, cost with a short, rounded thickening at first vein.

Length, 4.5 mm.; of wing the same.

Two males, State of Washington (U. K.).

Dolichopus occidentalis, n. sp.

Male. Antennae black, first joint yellow; cilia of inferior orbit yellow, of tegulae black; legs yellow, last joint of male fore tarsi greatly enlarged.

Face uniform pure yellow; front shining green; second segment of antenna black, sometimes partly reddish on the inner side. Thorax shining bluish-green, near the scutellum sometimes more blue; pleurae green, scarcely dusted. Abdomen bright green, near the tip with rather long black hairs on the posterior margins of the segments; hypopygium shining black,at base with a greenish or coppery lustre, the lamellae whitish, elongated, narrow, with broad black border at tip and the usual bristles. Fore coxae red, with numerous rather coarse hairs on the front side; middle and hind coxae black, tipped with yellow. Femora and tibiae yellow, the hind ones plain. Fore tarsi 1⅓ times the length of the tibiae; first two joints yellow, slender, stalk-like, third half as long as second, brownish, a little thickened; fourth exceedingly short, wider than long, black, with a few long hairs above; fifth nearly as long as the preceding three, flattened, obovate, with adense fringe of black hair above. Middle and hind tarsi blackened from tip of first joint. Wings hyaline, costa thickened somewhat before and far beyond the first vein, gradually tapering.

Length, 5.5 mm.; of wing 4.5 mm.

Two males, Washington (U. K.).

The females of *occidentalis* and *plumosus* will probably be readily distinguished from each other by the color of the antennae.

Dolichopus coquilletti, n. sp.

Male. Antennae black, first joint chiefly red; cilia of inferior orbit pale, of tegulae black; legs yellow, last joints of male fore tarsi enlarged.

Face grayish-yellow; front greenish-bronze; first joint of antennae narrowly black above, the remainder red. Dorsum of thorax bronze-green, considerably dusted; pleurae blackish, with gray dust. Abdomen shining bronze, scarcely at all greenish, before the incisures somewhat coppery. Hypopygium black, at base dusted, the lamellae whitish, rounded, with the usual jagged black margin and curved bristles at the apex. Fore coxae yellow, with coarse black hairs in front; middle and hind coxae black, with yellow tips. Femora and tibiae yellow, the hind ones simple. Fore tarsi 1½ times as long as the tibiae; last two joints slightly enlarged, black, with long hairs above; fifth joint as long as the third, not half as wide as long; empodium forming a small snow-white plume; third and second joints of tarsus gradually infuscated toward the tip. Middle and hind tarsi wanting in the described specimen. Wings almost hyaline, flexure of fourth vein quite abrupt, costa not swollen.

Length, 5.2 mm.; of wing 4.8 mm.

A single male; California (Coquillett).

The hind tarsi being broken off, I have trusted to the general appearance of the specimen in assigning it a place in the table. The fore tarsi of the male would in themselves distinguish the species. See the figure.

Dolichopus scapularis Loew.

Numerous specimens: Douglas Co., Kans. (U. K.), Northumberland Co., Pa. (Klages), Ohio (Weed), Knoxville, Tenn. (Summers). Dates of capture at Knoxville, May 19 to June 27; in Kansas, June 18 to July 7. The fore tarsi of the male are over once and a half the length of the tibiae, the same mistake occuring in Loew's monograph as in the following species.

Dolichopus funditor Loew.

Four males, one female, N. J. and Pa. (Johnson); June 28 to July 25. Loew's description should give the length of the fore tarsi as over once ànd a half that of the tibiae, instead of once and a quarter. I do not doubt that I have the females of this and the preceding species correctly determined, but I base the decision on the locality labels, associating each female with males from the same place. There appear to be no distinctive characters whatever.

Dolichopus aurifacies, n. sp.

Antennae red, cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi at base yellow.

Male. Face narrow, pure golden yellow; antennae red, third joint sometimes a little infuscated; front shining green. Dorsum of thorax

shining green: pleurae green with gray dust. Abdomen shining green; hypopygium small, with a greenish reflection at base, the remainder black; the lamellae have longer peduncles than usual, being inserted but little beyond the middle of the hypopygium; they are oval, with the usual jagged apex and curved bristles; the black border is not very well defined, and there are some scattered black dots on the white ground color of the organ. Fore and hind coxae yellow, the former with small pale hairs on the front side; middle coxae yellow with two black spots on the outer side. Femora and tibiae yellow; hind femora not ciliated, hind tibiae thickened, the hind side entirely glabrous; fore tarsi once and a half the length of the tibiae, simple, gradually blackened on the last three joints; middle and hind tarsi infuscated from the tip of the first joint. Wings broad, short, sub-hyaline, costa scarcely thickened.

Female. Face grayish yellow, fore tarsi missing in my specimen.

Length, 4.8 mm.; of wing, 4 mm.

Three males, one female; Knoxville, Tenn., May 16 and 17 (Summers); Lawrence, Kans., June 14 (U. K.).

Dolichopus germanus Wheeler.

Psyche, May, 1890, p. 341.

One male, and one female, Brookings, S. D. The fore tarsi of the female are perceptibly infuscated from the tip of the first joint.

Dolichopus grandis, n. sp.

Antennae red; cilia of inferior orbit pale, of tegulae black; legs yellow, hind tarsi yellow at base.

Male. Face whitish, yellow above; front green; tip of third joint of antennae somewhat infuscated. Head rather small in comparison with the large body. Thorax green, moderately shining, a narrow median stripe and two lateral, wider but less distinct stripes bronze; pleurae green, yellowish dusted. Abdomen coppery green; hypopygium more or less green at base, at tip black; the lamellae pale yellow, long, narrow, truncate at tip, the upper angle slightly acute; apex jagged, black-bordered, with curved bristles. Along the upper edge are dark small hairs, the black border beginning near the tip. Fore and hind coxae yellow, the former with a few black hairs at base, the rest pale; the latter considerably black at base. Middle coxae black, broadly yellow at tip. Femora and tibiae yellow, long and strong; the hind femora on the inner side of the apical half with rather short yellow cilia; hind tibia narrowly glabrous on the hind side. Fore tarsi one and one-half times the length of the tibiae; first joint yellow, half as long as the tibia; second joint decidedly longer, reddish brown, exceedingly thin vertically, glabrous on the sides, with a row of uni-

form black hairs above and below; last three joints black, of nearly equal length, compressed, the last joint slightly longer and more compressed, with a cluster of white hairs at the tip above the claws. Middle and hind tarsi black from tip of first joint. Wings yellowish, long, rounded at tip, narrowed at base; the third vein keeps close to the second to a point opposite the flexure of the fourth, then makes a broad curve backward, so that the submarginal cell is very broad before its tip, and again narrowed; costa thickened from the top of the first vein for a considerable distance.

Female. Face grayish white, broad; wings a little narrowed at base, the third vein only a little curved. Fore tarsi missing in my specimen.

Length, 6.5 to 7.5 mm.; of wing 6 to 6.5 mm.

Two males, one female, California (U. K).

Dolichopus willistonii, n. sp.

Shining green, feet yellow, cilia of inferior orbit pale, of the tegulae black, fourth vein not broken, antennae red.

Male. Face yellowish white, front shining green, antennae red, at most the tip of the short third joint brownish. Thorax thinly brownish dusted on the dorsum, shining; pleurae green with white dust. Among the black cilia of the tegulae are sometimes one or two white ones. Abdomen shining green above, white-dusted on the sides below; hypopygium not very large, the lamellae somewhat triangular, white, with wide black border along the upper and apical side, at the tip jagged and provided with stout incurved bristles; the white disk of the lamella is punctulate on the outer side. Coxae, femora and tibiae wholly yellow, except that the middle coxa has on its outer side two dark spots, one small and one large, hind tibiae on the inner side glabrous for 2/3 its length, the tip glabrous behind. Hind and middle tarsi infuscated from the tip of the first joint; first and second joints of front tarsi stalk-like, yellow, third joint compressed, short, yellow, the sides bare, with a white, satiny reflection; fourth joint longer than third, still more compressed, black, the apical end white and not so high; as far as the black extends there is along the upper edge a dense fringe of black hairs; fifth joint on its lower edge about as long as the fourth, greatly compressed, black, with a fringe above; on the end just above the claws it is produced considerably and above this is excised in a sharp angle running half way to the base of the joint; above this it is prolonged far beyond the lower lobe, turns up a little, and ends in a broad, conspicuous snow-white tip. The black fringe along the top ends at the beginning of this white portion. Pulvilli yellowish white, not conspicuous. Wings hyaline; second and third veins close together and both turning back at the tip, the latter especially.

Female. Face a little wider, legs and feet simple, second and third veins not so approximate.

Length, 5.5–6 mm.; of wing, 5 mm.

Eleven males and nine females, Douglas Co., Kans., June 17 to July 7 (U. K.).

Dolichopus pulchrimanus.

Bigot. Ann. Soc. ent. Fr., 1888, Bull. bimens; p. xxx, (*Spatichira pulchrimana*); l.c., 1890, 292 (*Spathichira pulchrimanus*).

M. Bigot has given us practically three descriptions of this species, as under the second reference he writes one in Latin and one in French. Unhappily, his account of the male fore tarsi is essentially different each time, and the remaining characters are far short of locating the species.

The genus Spathichira, founded by M. Bigot to include all species of Dolichopus in which the male fore or middle tarsi are notably enlarged, is wholly untenable. The species *funditor* which he selects as a type, is a perfect illustration of the inapplicability of the character for purposes of generic separation, since the female of *funditor* cannot be distinguished in any way from that of *scapularis*, a species in which the males have plain tarsi.

HYGROCELEUTHUS Loew.

This genus was based on three European species of Dolichopus, in which the face reaches the inferior corner of the eye. Subordinate characters were found in the wide wings and in the males' elongated antennae.

The species at present known in North America offer characters that interblend most curiously. Not one of the species could be distinguished in the female sex from Dolichopus by the length of the face alone. In *afflictus* and *crenatus*, Pacific coast species, the incision in the margin of the wing at the fifth vein is a good distinguishing mark; in *latipes* this is faint, in *ciliatus* absent. All the species but *ciliatus* have a thickened costa in the male, and the latter has a slight tubercle on the dorsal side of the vein. The Pacific species have the typical development of the antennae, characterized by a long, densely hairy first joint with a bare, red swelling on the inner side; second joint also enlarged in somewhat the same way; third joint *small*, with a thick, short-plumose arista. The other species show this peculiarity to a less degree.

Tables of Species of Hygroceleuthus.

MALES.

Middle feet enlarged . . . . *latipes*, Lw.
Tegular cilia black . . . . *ciliatus*, n. sp.
Second abdominal segment with long yellow hair on the sides. . .
. . . . *afflictus*, O. S.
Feet and abdomen plain, tegular cilia yellow. . . . . *crenatus*, O. S.

FEMALES.

1. First joint of antennae yellow, at most narrowly black along the upper edge . . . . *latipes*, Lw.
   First joint chiefly black 2
2. Cilia of tegulae coarse, wholly black . . . . *ciliatus*, n. sp.
   Cilia mixed above and below with yellow 3
3. Fourth vein with an unusually pronounced flexure. . *afflictus*, O. S.
   Fourth vein with the ordinary flexure . . . . *crenatus*, O. S.

Hygroceleuthus latipes Loew.

The figure in Loew's monograph (N. A. Diptera II. pl. iii, 1) incorrectly represents the middle tarsi of the male as being flattened, instead of compressed; the first joint of the antenna, also, is more hairy than shown, and the face of the female does not reach the inferior corner of the eye. In the description (p. 18), line 10, "tibiae" should read "femora." The first joint of the antenna is not at all blackened in most of my specimens; the thickening of the costa is peculiar to the males.

Numerous specimens. Brookings, S. D. (common in September); Wyoming; Connecticut.

Hygroceleuthus crenatus O. S.

Numerous specimens from California, and two from Washington. Osten Sacken's material was not sufficient to enable him to discover one very interesting fact concerning the tegular cilia of this species and *afflictus*. In the male they are light yellow, fine and delicate; in the female they are of ordinary size and black, except a few of the smaller ones above and below, which are yellow.

A single male from Washington differs from the rest in having the antennae slightly longer, blacker, and more hairy; and the arista shorter and more densely hairy (see figure). These differences in a single specimen do not justify the erection of a new species.

Hygroceleuthus afflictus O. S.

One male and two females, California (Coquillett). The male is easily distinguished by the bunch of yellow hair on each side of the

second abdominal segment. It reaches to the middle of the fourth segment in the specimen examined. A character shared by both sexes that readily separates the species from *crenatus* is the flexure of the fourth vein; it is much more pronounced in *afflictus*. The cilia of the tegulae, yellow in *crenatus*, are black in *afflictus*. Osten Sacken's short comparative description of the female of the former may be repeated for the female *afflictus*.

Hygroceleuthus ciliatus; n. sp.

Shining green, antennae black except inner side of first joint, cilia of tegulae long and black.

Male. Face covered with yellowish white pollen; palpi yellow, proboscis brown. Front green, antennae long; first joint red and somewhat enlarged on the inner side, above and on the outer side with stout black hairs; second joint black, rather long but not enlarged; third joint not very small, black with subapical bare arista. Cilia of inferior arbit light yellow.

Thorax shinning green, with strong bristles. Pleurae agreen, but slightly dusted; the area before the humeral spiracle and above the fore coxa has a black bristle and a few whitish hairs. Halteres and tegulæ yellow, the latter with long black cilia.

Abdomen green, somewhat bronzed, the sides of the first segment have some white hairs. Lamellæ of hypopygium small, black bordered and fringed as usual.

Fore coxæ black on the posterior side; the anterior with fine white hairs and three or four black bristles. Middle coxæ black except at tip, with white hairs and black bristles. Hind coxæ yellow at tip. Femora and tibiæ yellow; tips of hind tibiæ blackish. Tarsi simple, black from tip of first joint. Wings narrow, hyaline, the costa viewed at right angles to the wing is not thickened, still in a certain direction there is a noticeable protuberance just beyond the end of the first vein. The fourth vein is strongly curved forward, and ends far before the apex of the wing. Posterior margin but little indented at the fifth vein.

Female. Face wider and shorter, costa simple. Antennæ slightly shorter, the third joint relatively larger.

Length, 4 mm.; of wing, the same.

Two males, Custer, S. D.; two females, Wyoming.

Hygroceleuthus lamellicornis.

Thomson, Eugenies Resa. 511, 114 (Dolichopus).

This species was based on a single female specimen, evidently a near relative of *afflictus* and *crenatus;* but the rather lengthy descrip-

tion omits the distinctive characters. Baron Osten Sacken thought it could not be the same as *crenatus*, and there are exactly the same reasons, now that the female of *afflictus* is known, why it can not belong to that species. It has never been recognized.

NOTE.—The name *agilis* is preoccupied for the genus *Dolichopus;* I wish to substitute *coloradensis* for it in this article.

Present Status of the Street Paving Problem in Kansas.

BY E. C. MURPHY.

This paper is not in any sense intended as a comparison of the "public spirit" of the people of the cities of Kansas, and indeed it cannot be since street improvement is only one of several public improvements which cities are making. For example: one city engineer reports that the only street pavement that his city has is one and four-tenths miles of broken stone, but they have good sidewalks and a system of sewers, this city having concentrated her energies mainly in this latter direction. The writer wishes simply to present some statistics on this subject collected by him, and some facts drawn from them as to the present condition of the streets of the cities of Kansas, and the cost of their construction and maintenance.

These statistics have been gathered from answers to printed questions sent to the city engineer of each city. They are, as nearly as may be, in the language of the answers to the questions. The writer thinks it unnecessary to mention the name of each city engineer but wishes to express to each his thanks for the information so kindly furnished.

KANSAS CITY, KANSAS,--population 38,316; has 2.52 miles broken limestone, thirteen inches in thickness, costing $2.78 per sq. yd.; 18.82 miles cedar block pavement, laid on concrete, costing $1.50 per sq. yd.; 1 mile vitrified brick, laid on concrete, costing $1.75 per sq. yd.; 1.02 miles asphalt laid on concrete, costing $2.80 per sq. yd.; 0.17 mile of granite and Colorado sand stone block, laid on concrete, costing $3.00 per sq. yd.

TOPEKA,—population 31,007;has 34,445 sq. yds. red cedar block laid on concrete; 3,520 sq. yds. white cedar block, laid on concrete; 51,315 sq. yds. Colorado sandstone, laid on sand; 10,578 sq. yds. native blue limestone; 70,860 sq. yds. vitrified brick, laid on sand, costing from $1.28 to $1.78 per sq. yd; 193,579 sq. yds. asphalt laid on concrete, costing $2.80 per sq. yd. The only paving laid in 1892 was 46,893 sq. yds. of brick. This city has no broken stone pavement.

WICHITA,—population 23,853; has 0.38 mile brick, laid on concrete, costing $2.025 per sq. yd.; 2.33 miles asphalt, laid on concrete,

costing $2.80 per sq. yd.; 1 mile Colorado sand stone block, laid on sand, costing $2.45 per sq. yd. The cost of maintenance of the asphalt pavement was 10 cents per sq. yd. after five years of use.

LEAVENWORTH,—population 19,768; has 4 miles cedar block, costing $1.88 per sq. yd.; 9 miles broken limestone, 12 inches in thickness, costing $0.50 per sq. yd.

ATCHISON,—population 13,963; has 1.96 miles of cedar block, laid on concrete, costing $1.90 per sq. yd.; 0.55 miles Bois D'arc block, laid on concrete, costing $3.83 per sq. yd.; 3.33 miles of Atchison vitrified brick laid on sand, costing $1.65 to $2.00 per sq. yd.; 5.76 sq. yds. lime stone block, laid on sand, costing $1.44 per sq. yd.; 2.42 miles broken lime stone, costing $.60 per sq. yd. This city has abandoned the use of broken stone pavement and has paved several of her old macadamized streets with brick. The cedar block pavement has proved a failure in this city and will be replaced by brick. The Bois D'arc block pavement which has been down for six years on one of the principle business streets shows no signs of wear. It is expected to last twenty-five years.

FORT SCOTT,—population 11,946; has 5 miles broken lime stone from 6 to 8 inches in depth, costing $0.35 and upwards per sq. yd.

LAWRENCE,—population 11,000; has 1 mile broken lime stone one foot in depth, —— feet of this have an eight inch Telford base covered with four inches thickness of broken stone, costing $0.45 to 0.50 per sq. yd. Had 0.75 mile pine and cotton wood block pavement laid in 1870, costing $.25 per sq. yd., which lasted six years.

HUTCHINSON,—population 8,682; has no pavement of any kind but the city is now covering a portion of the streets with cinders from the salt works.

ARKANSAS CITY,—population 8,347; has 8.5 miles of broken limestone, the average cost of which was $0.33 per sq. yd. A part of this is six inches in depth, covered with two additional inches of gravel, the remainder is eight inches of broken stone covered with two inches of gravel. The cost of maintenance is $200. per year.

EMPORIA,—population 7,551; has 15 miles of broken stone pavement, covered with two inches of gravel.

PARSONS,—population 6,736; has 7,000 linear feet of broken limestone pavement, costing $0.35 per sq. yd.

PITTSBURG,—population 6,697; has 1 mile vitrified brick, laid on residuum, costing $1.58 per sq. yd. Has no broken stone pavement, and prefers brick to any other surface covering.

OTTAWA,—population 6,248; has 1 mile broken limestone, costing $1.20 per cubic yd.; 9,000 sq. ft. limestone, set on edge on natural surface, costing $0.60 per sq. yd.

SALINA,—population 6,149; has no paved streets.

WINFIELD,—population 5,184; has two miles broken stone pavement from six to nine inches in thickness covered with from three to six inches gravel. It was constructed at different times with the poll tax. About 0.5 miles was added in 1892.

WELLINGTON,—population 4,391; has no broken stone or other kind of street pavement.

OLATHE,—population ———; has 1 mile broken stone pavement, costing $0.55 to $1.49 per sq. yd. It has a seven inch Telford base covered with four inches thickness of broken limestone. It has been in use four years and has cost comparatively nothing for repairs.

ABILENE AND CLAY CENTER; "our streets are all paved with Kansas dirt."

Haskell road from the city of Lawrence to Haskell Institute, a distance of one and one-fourth miles, is constructed of broken limestone twelve inches in thickness at the center and nine inches at the sides, twelve feet from the center. The cost including grading was $0.40 per sq. yd.

Table 1 gives the amount and cost of each kind of pavement and the total length of pavement in each city, and the total length of each kind of pavement in Kansas.

The number of miles of pavement in Topeka given in the table is on the assumption that the average width of pavement is thirty feet.

	Miles Stone Block.	Cost per sq. yd.	Miles of Asphalt.	Cost per sq. yd.	Miles Wood Block.	Cost per sq. yd.	Miles Brick.	Cost per sq. yd.	Miles Broken Stone.	Cost per sq. yd.	Total No. Miles.
Kansas City..........	.17	$3.00	1.02	$ 2.80	18.82	$ 1.50	1.00	$ 1.75	2.52	$ 0.87	23.53
Topeka	3.51	......	11.00	2.80	2.16	......	4.03	{ 1.28 / 1.78	......	......	20.70
Wichita..............	1.00	2.45	2.33	2.80	......	......	0.38	2.03	......	......	3.70
Leavenworth.........	......	......	......	......	4.00	1.88	......	......	9.00	0.50	13.00
Atchison..............	0.04	1.44	......	......	1.96	1.90	3.33	{ 1.65 / 2.00	2.42	0.60	* 8.30
Fort Scott...........	......	......	......	......	......	......	......	......	5.00	{ 0.35 upw's	5.00
Lawrence............	......	......	......	......	......	......	......	......	2.25	{ 0.40 / 0.50	2.25
Hutchinson...........	......	......	......	......	......	......	......	......	......	......	......
Arkansas City........	......	......	......	......	......	......	......	......	8.50	0.33	8.50
Emporia.............	......	......	......	......	......	......	......	......	1.50	......	1.50
Parsons..............	......	......	......	......	......	......	......	1.58	1.33	0.35	1.33
Pittsburg	......	......	......	......	......	......	1.00	......	......	......	1.00
Ottawa...............	† 0.06	0.60	......	......	......	......	......	......	1.00	0.40	1.06
Salina	......	......	......	......	......	......	......	......	......	......	......
Winfield	......	......	......	......	......	......	......	......	2.00	......	2.00
Wellington	......	......	......	......	......	......	......	......	......	......	......
Olathe	......	......	......	......	......	......	......	......	1.00	{ 0.55 / 1.49	1.00
Total................	4.78	......	14.35	......	26.94	......	9.74	......	36.52	......	*92.87

* Includes .55 mile of Bois D'Arc block pavement.
† Stone set on edge.

From table 1 we see that only about ninety-three miles of the roads and streets of Kansas are paved, a length equal to 90 per cent. of the length of the streets of the capital city, Topeka.

Of the ninety-three miles of paving 5.6 per cent. is stone block, 15 per cent. asphalt, 29 per cent. wood block, 10.5 per cent. brick, and 39.5 per cent. broken stone.

The cost of stone block pavement has varied from $1.44 to $3.00 per sq. yd. The latter being granite laid on concrete, the former native limestone laid on sand.

The cost of asphalt pavement has been the same in the three cities in which it has been used, namely, $2.80 per sq. yd.

The cost of wood block pavement has varied from $1.50 to $1.90 per sq. yd. It was all laid on a concrete foundation. This pavement has not proved a success in Kansas and is being replaced, as it wears out, with brick, asphalt or stone block.

The cost of broken stone pavement has varied from $0.33 to $1.49 per sq. yd. The former is only eight inches in depth, two inches of which are gravel. From $0.50 to $0.75 per sq. yd. for a depth of twelve inches is believed to be a fair price for this kind of pavement if the length of haul is not great. This kind of pavement is not used in two of our larger cities, and is being replaced by other kinds of pavement in other cities on streets of large traffic.

The cost of maintenance of the different kinds of pavement is difficult to get. In most cases a separate record of this item is not kept. In some cases the pavement has not been in use long enough to need repairs, several engineers reporting in regard to maintenance, "nothing as yet." The city engineer of Arkansas City reports the cost of maintenance of 8.5 miles of broken stone pavement $200, or $23.53 per mile per year.

Maximum Load on a Lintel.

BY E. C. MURPHY.

The following method of finding the maximum load carried by a lintel, or the transverse strength of masonry, is an outgrowth of an attempt to make clear to my students in masonry construction a method of finding the "strain which may come upon a lintel or girder used to support a brick wall over an opening" given in Professor I. O. Baker's Treatise on Masonry Construction.

The masonry over the opening is assumed to act as a beam fastened firmly at the ends, hence the wall must be built up slowly so as to allow the mortar time to harden and attain strength enough to enable the masonry to act as a beam.

It will perhaps conduce to clearness if we assume that the wall over the opening is built up of thin boards instead of courses of masonry. Let, then, a long thin board be placed across an opening and fastened at the ends; it will sag in the center and will need one or more supports to keep it in place vertically. If a second board be placed on top of this first one and fastened firmly to it so that there is no slipping between them, the stiffness of the two combined in this way will be greater than the two placed side by side, or placed one on top of the other without being fastened together. In consequence of this added stiffness, or beam action, a less amount of the added weight will be carried by the temporary supports than would be carried if there were no beam action or resistance. If a third board be fastened to the two preceding ones in the way indicated, the stiffness of the three boards combined is greater than that of the first two combined, and hence the proportion of the weight of the third board carried by the temporary support is less than the proportion of the weight of the second carried by three supports. After a few boards have been added in this way a point is reached where the increase in stiffness is sufficient to offset the added weight. The weight on the temporary support is now a maximum. The next board added will increase the stiffness so that, not only is no weight added to the temporary supports, but some of the weight caused by the other boards is taken off the the temporary supports. Adding a few more boards in the same way we have a beam stiff enough to carry its own weight without sagging or one which is self-supporting. From this we see that the weight on

the temporary supports, or on the lintel in case of masonry, increases as the beam or masonry is built up to a height H_n and then decreases from H_n to some height H_s where it is zero, and for this latter height the temporary supports or the lintel may be taken away without affecting the stability of the wall.

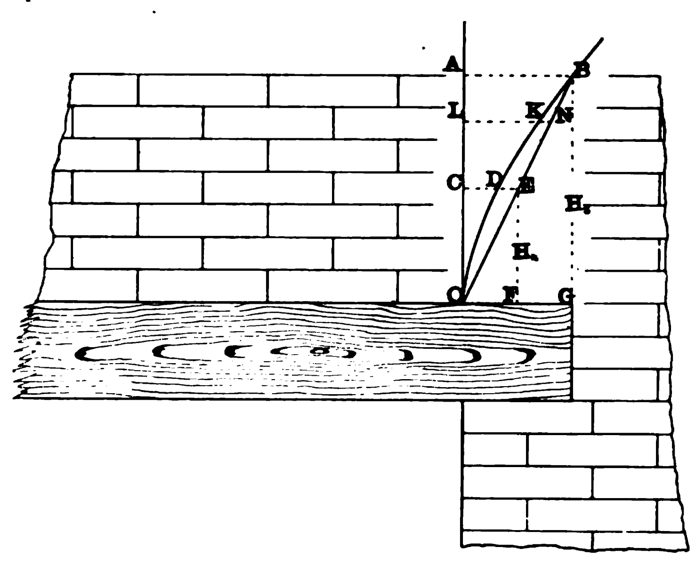
Let the figure represent a brick wall spanning an opening.

H = any height in feet of wall over opening.

H_n = height in feet of wall producing maximum load on or stress in lintel.

H_s = height in feet of wall which is self-supporting.

S = span in feet.



t = thickness of wall in feet.

q = weight in lbs. per cub. ft. of masonry.

W = total weight of wall over opening.

R = modulus of rupture in lbs. per sq. inch.

The weight of the wall over the opening,

$$W = q\,S\,t\,H \ldots\ldots (1).$$

and the moment of this weight about any point of the beam varys directly with H for a given wall. This latter is represented by the line OB in the figure.

When the wall is self-supporting we have from resistance of material one-twelfth of the weighth of the wall over the opening multiplied by the span equals one-sixth of the tensile strength multiplied by the thickness and by the square of the height of the wall or

$$\tfrac{1}{12}\,(q\,S\,t\,H_s)\,S = \tfrac{1}{6}\,(144\,R)\,t\,H_s^2 \ldots\ldots (2).$$

Substituting for q a value 144 in (2); that is assuming the brickwork to weigh 144 lbs per cub. ft. and solving for H_s we have

$$H_s = \frac{S^2}{2R} \ldots\ldots (3).$$

From the second member of (2) we see that the resisting moment of the beam varies as H^2 or

$$Q = c\ H^2 \ldots\ldots (4),$$

c being a constant and Q the resisting moment. Equation (4) represents a parabola whose axis is horizontal and is the curve OBD in the figure.

Any horizontal line, as LN, between the vertical and OB is proportional to the moment of the weight of the wall of height H. Any line as LK is proportional to the resisting moment of the wall of height H and the difference of the lines LN and LK is proportionally to the load carried by the lintel when wall is at height H. This weight carried by the lintel is zero at B since the wall whose height is H_s is self supporting.

From a property of the parabola the intercept between the curve and a chord is a maximum at the middle of the chord, hence

$$H_n = \tfrac{1}{2} H_s \ldots\ldots (5).$$

That is, the height of the wall which produces the maximum stress in the lintel equals one half the height of the self-supporting wall.

From the parabola we have $\frac{CD}{AB} = \frac{{H_n}^2}{{H_s}^2} = \frac{1}{4}$.

From similar triangles $\frac{CE}{AB} = \frac{H_n}{H_s} = \frac{1}{2}$, hence

$$DE = \tfrac{1}{2}\ CE \ldots\ldots (6).$$

That is, when the height of the wall is such as to produce a maximum load on the lintel only one-half the weight of this wall is carried by the lintel.

From (2), (5) and (6) we find the maximum load carried by the lintel

$$P = \frac{18\ t\ S^3}{R} \text{ lbs., nearly} \ldots\ldots (7).$$

The Trisection of an Angle.

BY A. L. CANDY.

The ancient geometricians were chiefly concerned with three problems; namely, the duplication of a cube, the trisection of an angle, and the squaring of a circle. Hippocrates of Chios (born 470 B. C.) reduced the first of these to that of finding two geometric means, x and y, between one straight line a and another twice as long 2a; for if $a : x = x : y = y : 2a$, then $x^3 = 2a^3$; but he failed to find these means. It was subsequently proved (probably about 1600 A. D.), by Vieta, a French mathematician, that the first two of these problems, considered analytically, require the solution of a cubic equation; and since a construction by means of circles, whose equations are of the form $x^2 + y^2 + ax + by + c = 0$, and straight lines, whose equations are of the form $a'x + b'y + c' = 0$, is only equivalent to the solution of a quadratic or a biquadratic equation, these problems are not soluble if we are restricted to lines and circles. In the second century A. D., Nicomedes invented the Conchoid and Diocles invented the Cissoid, both curves being used to give a solution of the duplication problem, and probably the former was also used to trisect an angle. If this property of the curve was known to Nicomedes it was doubtless a part of the cause that led to its invention. Be this as it may, in 1677 Viviani, a pupil of Galileo, showed how this problem could be solved by the aid of this curve; he also showed how an angle could be trisected by the aid of the equilateral hyperbola. Such is the brief history of these famous problems.

Modern mathematicians have not considered them of sufficient importance to merit special attention. Indeed it is not now claimed that the trisection of an angle is of any practical value or of much interest save that which clusters around its history; but it is believed that, probably, at least three of the solutions here given are new. The solutions by means of the hyperbola are possibly old; if so, their publication in this series is justified by their intimate relation to the other methods; if not, their promulgation calls for no apology.

All the methods of solution herein presented are based upon a simple theorem in Elementary Geometry and developed from it

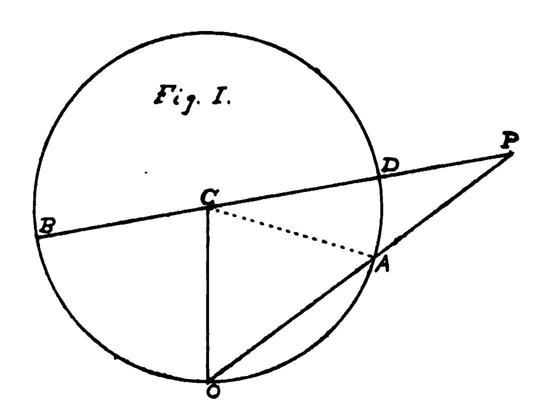
analytically by means of the process of Geometric Inversion. This theorem which is partially expressed in Wentworth's Geometry, Ex. 124, may be stated in full as follows :

Theorem I. If through a fixed point O on the circumference of a circle whose center is C, a secant OAP (or AO P) is drawn, meeting the diameter BC (produced) in P, so that the exterior segment (or whole secant) AP is equal to the radius, the angle P is equal to one-third the angle OCB ; also, if the diameter BC meet the chord AO in P, making AP equal to the radius, the angle APC is equal to one-third the reflex angle OCB.

As the proofs of all the constructions explained in this paper are deduced from the principle here establishd, it is desirable to give the following easy demonstration of the three cases of the preceding theorem.

PROOF OF THEOREM I.

CASE I. When AP is the exterior segment of the secant (See fig. I).



Let the diameter BCD (produced) meet the secant OAP in P, making AP equal to the radius.

To prove $\angle P = \frac{1}{3} \angle OCB$.

Draw AC.

Then $\angle P = \angle ACP =$ Arc AD.

Also $\angle P = \frac{1}{2}$ Arc OB $- \frac{1}{2}$ Arc AD $= \frac{1}{2} \angle OCB - \frac{1}{2} \angle P$.

$\therefore \angle P = \frac{1}{3} \angle OCB$.

Cor. $\angle AOC = 2 \angle P = \frac{2}{3} \angle OCB$.

CASE II. When AP is the whole secant (See fig. II).

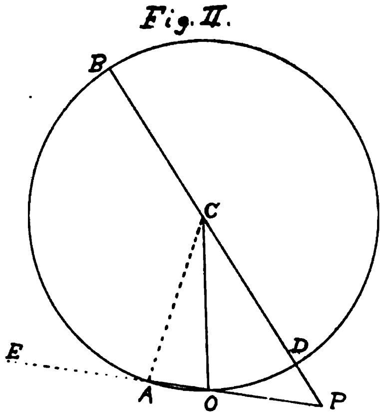


Fig. II.

Let the diameter BCD (produced) meet the secant AOP in P, making AP equal to the radius.

To prove $\angle P = \frac{1}{3} \angle OCB$.

Draw AC.

$\angle P = \frac{1}{2}$Arc AB$-\frac{1}{2}$Arc OD

$= \frac{1}{2}$(Arc AB$+$Arc AO)$-\frac{1}{2}$(Arc OD$+$Arc A O)

$= \frac{1}{2}$Arc OB$-\frac{1}{2}$ Arc AD$= \frac{1}{2} \angle OCB - \frac{1}{2} \angle P$.

$\therefore \angle P = \frac{1}{3} \angle OCB$.

Cor. $\angle COP = \frac{2}{3} \angle OCB$, since $\angle COP = \angle CAE = 2 \angle P$.

CASE III. When AOP is a chord (See fig. III).

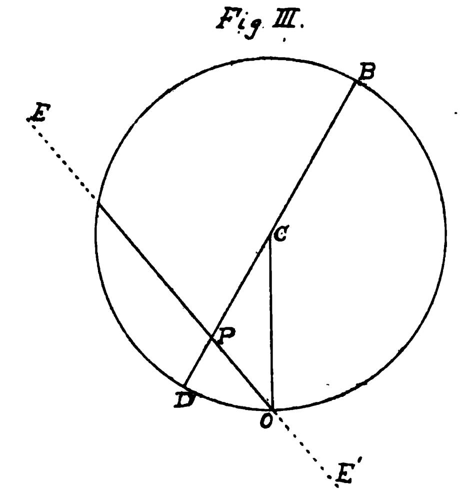


Fig. III.

Let the diameter BCD meet the chord AO in P, making AP equal to the radius.

To prove $\angle APC = \frac{1}{3}$ Reflex $\angle OCB$.

Draw AC.

$\angle APC = \frac{1}{2}$ Arc OD$+\frac{1}{2}$ Arc AB.

$= \frac{1}{2}$ Arc OD$+\frac{1}{2}$ Arc A D$+\frac{1}{2}$ Arc A B$-\frac{1}{2}$ Arc AD.

$= \frac{1}{2}$ Arc OAB$-\frac{1}{2}$ Arc AD.

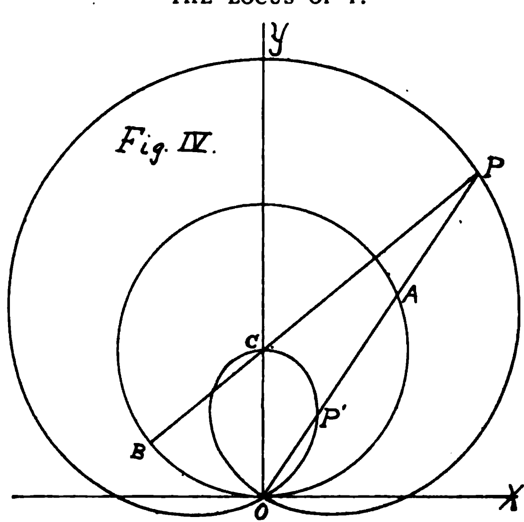
$=\frac{1}{2}$ Reflex $<OCB-\frac{1}{2}<APC$, since $<APC=<ACP$

$\therefore <APC=\frac{1}{3}$ Reflex $<OCB$.

Cor. $<COE'=<CAE=2<APC=\frac{2}{3}$ Reflex $<OCB$.

Now suppose the line OAP to revolve about O, (any fixed point on the circumference of a circle) and AP to remain equal to the radius of the circle. Then it is asserted that if the locus of P be determined, a given angle can be trisected by the aid of this curve.

THE LOCUS OF P.



To find the polar equation of the locus of P, let O (fig. IV) be the pole and OX, tangent to the circle at O, be the initial line; let OP$\equiv$$R$, $<POX\equiv\theta$, and R$\equiv$Radius of the circle.

Then the equation of the circle, the locus of A, is

$$R=2\,\mathrm{R}\sin\theta.$$

Therefore, since AP=R, the equation of the locus of P is

(1) $$R=2\,\mathrm{R}\sin\theta+\mathrm{R}=\mathrm{R}\,(2\sin\theta+1).$$

To transform this equation from polar to rectangular co-ordinates, let O be the origin and OX the axis of abscissæ.

$$\text{Put } R=\sqrt{x^2+y^2} \text{ and } \sin\theta=\frac{y}{R}=\frac{y}{\sqrt{x^2+y^2}}$$

Whence by substituting in (1) and reducing we get

(2) $$x^2+y^2=\mathrm{R}\,(2y\pm\sqrt{x^2+y^2})$$

In order that (1) may represent the complete locus obtained by using both the plus and minus values of the radical term in (2) the equation must be written

(3) $$R=\mathrm{R}\,(2\sin\theta\pm1)$$

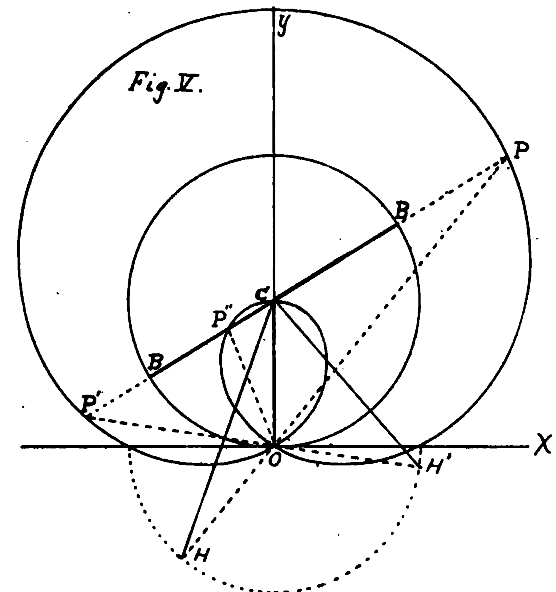
The minus sign in both of these equations gives the locus of P', where AP'=R.

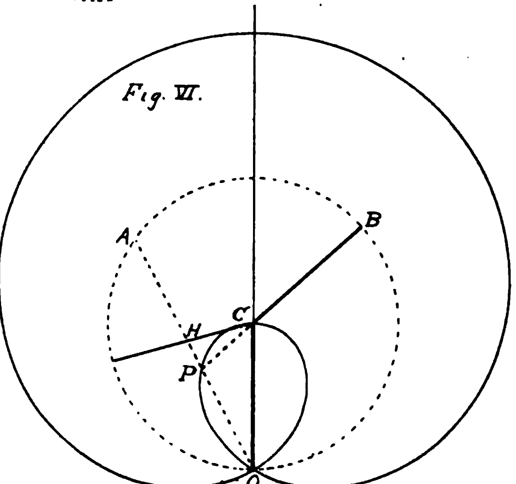
Equations (2) and (3) show that the curve is a particular case of Pascal's Limaçon, as is shown in fig. IV.

Let us now proceed to the trisection of an angle.

FIRST METHOD.

Let OCB be the given angle.





(See fig. V when given angle is acute or obtuse and fig. VI when it is reflex.)

With the vertex C as center and with any convenient radius describe the Directric Circle,* cutting the sides of the angle in O and B. With O as origin and OC as axis of y describe the limaçon determined by equation (3).

Produce BC to meet the limacon in P.

Also draw PO and prolong it to H, making OH=OC.

Then HC trisects <OCB, since <HCO=$\frac{1}{3}$ <COP.

*This fact explains the meaning and also the reason for using the name "Directric Circle"

Likewise, if CB be produced to meet the limaçon in P' and P'OH' be drawn, making OH'=OC, then H'C trisects the supplementary <OCB.

For proof see The. I: Case I, when <NCB is less than 135°;

Case II, when <OCB is greater than 135° and is less than 180°;

Case III, when <OCB is less than 180°.

An angle of any magnitude is trisected with equal facility.

It is interesting to notice in this connection the following somewhat remarkable property of this particular quartic.

Since <COP=$\frac{1}{3}$ <OCB and <COP'=$\frac{1}{3}$ ∢OCB', [fig. V.]

∴ P'OP''=120°.

Also <P'=OCB' and <OP''P'=$\frac{1}{3}$ Reflex ∢OCB',

∴ : <P'OP''=60°.

Therefore, any line drawn through the center of the Directric Circle and terminating in the outer branch of the quartic, subtends at the double point a constant angle of 120°, of which the line joining the double point to its intersection with the inner branch is the bisector.

Also by expanding equation (2) and placing the second degree terms equal to zero, we find for the equations of the tangent lines at the double point



$$3y^2-x^2=0.$$

This equation shows that these tangents also intersect at angles of 60° and 120°.

SECOND METHOD.

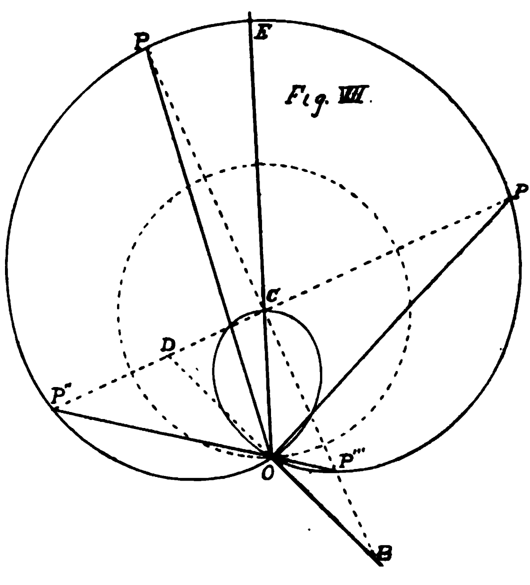
Let BOE (fig. VII) be the given angle. With O as origin and OE as the axis of ordinates describe the limaçon determined by equation (3).

On the side of OE take OC equal to the radius of the Directric Circle.

Produce BO to D, making OD=OC.

Draw DC and produce it to meet the limaçon in P.

Then will PO trisect the angle BOC.



Proof, $\angle COP = \frac{2}{3} \angle OCD$. (Theorem I, Cor.)

But $\angle OCD = \frac{1}{2} \angle BOC$.

$\therefore \angle COP = \frac{1}{3} \angle BOC$.

Similarly if OB be taken equal to OC, and BC be prolonged to to meet the limaçon in P', then

P'O trisects the supplementary angle COD.

Also, if CD be produced to P'', and BC intersects the limaçon in *R'''*, then

P''O trisects the reflex angle COB and

P'''O trisects the reflex angle COD,

since $\angle POP'' = \angle P'OP''' = 120°$.

$\therefore$ P''OP''' is a straight line.

It is now perfectly clear that this method of solution is also applicable to an angle of any magnitude.

INVERSION OF FIG. IV FROM O.

Interchanging x and y in equation (2) so that the curve will be symmetrical with respect to the axis of x, we get

(4) $x^2 + y^2 = R(2x \pm \sqrt{x^2 + y^2})$.

(5) Putting $x = \dfrac{x'}{x'^2 + y'^2}$ and $y = \dfrac{y'}{x'^2 + y'^2}$, reducing and dropping the primes, (4) becomes

(6) $3x^2 - y^2 - \dfrac{4x}{R} + \dfrac{1}{R^2} = 0$,

the equation of a hyperbola with the origin at the left hand focus, and the semi-major axis equal to $\dfrac{1}{3R}$.

Transferring the origin to the center and then putting $A = \dfrac{1}{3R}$, equation (6) reduces to

(7) $3x^2 - y^2 = 3a^2$

which shows that the excentricity (e) is equal to 2.

The equation of the directric circle is

(8) $x^2 + y^2 = 2Rx$.

Substituting formulæ (5) in (8), reducing, transferring the origin as in (6) and putting $a = \dfrac{1}{3R}$, we obtain

(9) $x = -\dfrac{a}{2}$,

the left hand directrix.*

---

* This fact explains the meaning and also the reason for using the name "Directric Circle."

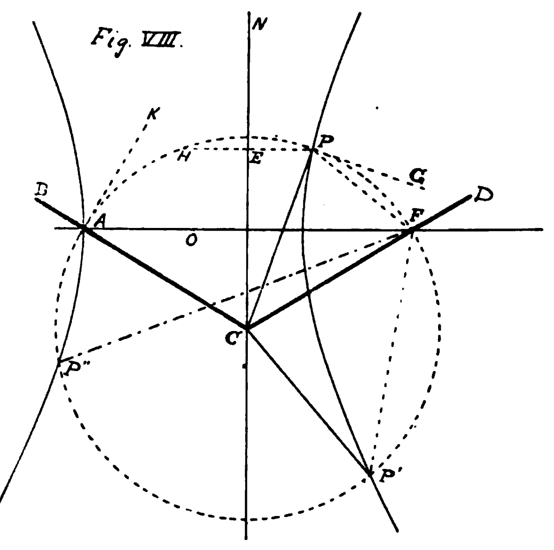
The straight line PB inverts into a circle through the left hand vertex, and therefore with its center on the directrix. The line PO is not changed by inversion and therefore becomes a focal radius of the hyperbola.

Since the magnitude of an angle is not changed by the process of inversion, the following *Inverse Theorem* is now completely established.

Theorem II. If a circle is described, having for its center any point on the directrix of a hyperbola whose eccentricity is 2, passing through the nearer focus and farther vertex, and intersecting the nearer branch of the curve in P, the angle which it makes with the shorter focal radius drawn to P is equal to one-third the angle it makes with the axis at the farther vertex.

THIRD METHOD.

Let BCD (fig. VIII) be the given angle. Take CF=CA, any convenient length. With F as focus and A the more remote vertex, construct the hyperbola whose eccentricity is 2.



With C as a center, describe a circle passing through A and F, and intersecting the hyperbola in P, P', and P''.

Then PC trisects the angle ACF.

Proof. The vertex C lies on the directrix CN, which is the perpendicular bisector of AF.

Draw the tangents PG and AK.

Then $<FPG = \frac{1}{3} <FAK$. (Theorem II.)

$\therefore <FCP = \frac{1}{3} <ACF$.

Likewise $<P'CF = \frac{1}{3}$ the reflex angle ACF.

The direct proof* of this method is also very simple.

Draw PEH perpendicular to CN.

*This solution has recently been given by Mr. L. C. Duncan of Holton, Kan., who worked it out directly and independently. It is included in this paper because it naturally belongs to the series of solutions here presented.

Then PF=2PE=PH, since e=2.

∴ arc FP=Arc PH=Arc AH=$\frac{1}{3}$ Arc APF.

Since PC also trisects <FCN, one side of the given angle could have been taken for the directrix.

Now the lines OP, OP' and OP'' (fig. V) invert into FP, FP' and FP'' (fig. VIII) respectively,

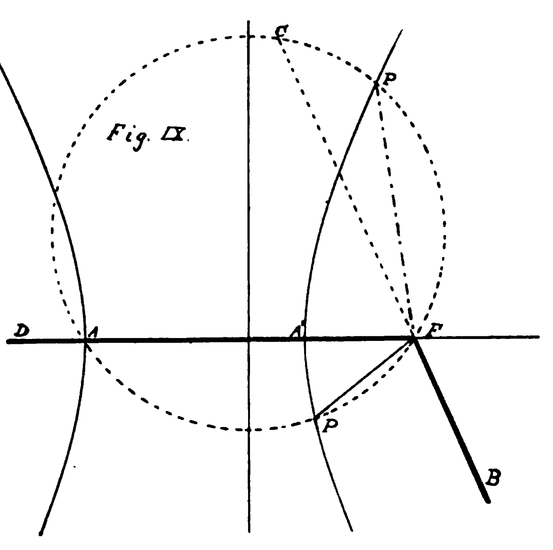
∴ P''F bisects <PFP', and hence P, P', and P'' trisect the circle.

FOURTH METHOD.

Let DFB (fig. IX) be the given angle. With F as focus and FD as axis construct a hyperbola whose eccentricity is 2 and intersecting FD in A and A'.

Produce BF to C, making FC=FA.

Pass a circle through A, F, and C, intersecting the hyperbola in P and P'.



Then PF trisects <AFB and P'F trisects the reflex <AFB.

Proof. This is the Inverse of the Second Method and is therefore proved by Theorem (II) since <AFB=Arc APF.

The direct proof is the same as in the preceding solution.

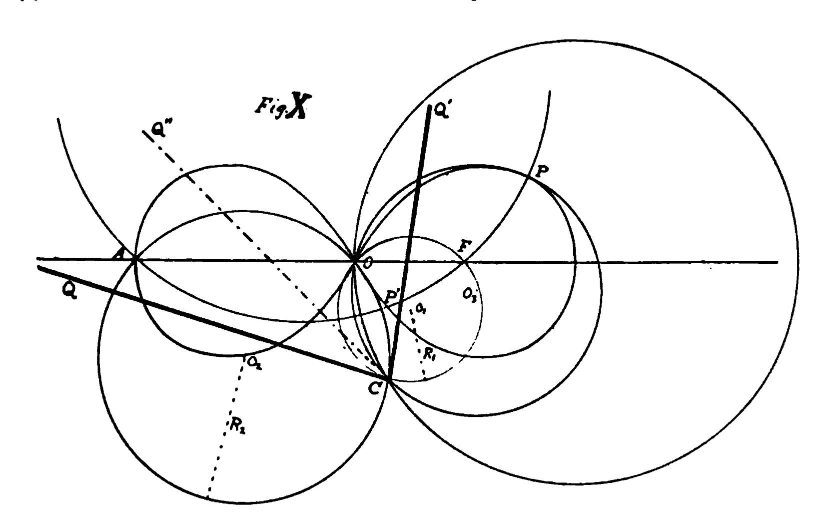
INVERSION OF FIG. VIII FROM O, THE CENTER OF THE HYPERBOLA.

Substituting formula (5) in (7), and reducing and dropping the primes, we get

(10) $$(x^2+y^2)^2=\frac{a^2}{3}(3x^2-y^2), \text{ where } a=\frac{a}{1} \text{ of } (7),$$

a curve of the fourth degree, consisting of two equal symmetrical loops, forming approximately a figure 8, and having the origin for a double point.

The following (fig. X) is the inverse figure; the points A, C, F, P and P' being the inverse of the corresponding points of fig. VIII.



The directrix CN inverts into a circle whose radius is equal to the value of (a) in (10). The circle inverts into a circle whose center is on CO, passes through A and F, and intersects the right loop of the quartic in P and P'.

AC, FC, and PC invert into circles through (O, A, C), (O, F, C) and (O, P, C), respectively. Then the circle OPC trisects the angle at C, formed by the circles OAC and OFC.

FIFTH METHOD.

Let QCQ' (fig. X) be the given angle.

Draw the circles O_1 and O_2 tangent to QC and Q'C, respectively, at C, so that their other point of intersection (O) shall lie within the given angle; also make their radii satisfy the condition

$$R_1 : R_2 = 1 : 2,$$

since this is the inverse ratio of the distance of the lines FC and AC (fig. VIII) from (O), the center of inversion.

Draw the secant AOF so that

$$OF : OA = 1 : 2.$$

With O as double-point, A as vertex of left loop, and F as focus of right loop, draw the quartic which is represented by (8).

With center on CO, describe a circle passing through A and F, and intersecting the right loop of the quartic in P and P'.

Pass the circle O_3 through P, O, and C, and draw Q''C tangent to O_3,

$$\text{then } \angle QCQ'' = \tfrac{1}{3} \angle QCQ'.$$

Also, the tangent to a circle through P', O, and C trisects the corresponding reflex QCQ'.

Since angles remain unchanged in the process of inversion, these results are already proved by what has preceded.

A similar process of inversion cannot be applied to the fourth method, because in that case the solution is performed by taking a fixed distance on a line which does not pass through the center of inversion.

If it were desirable to have a solution adapted to practical purposes, the first and second of the preceding series could be used with great facility, since the curve by means of which the results are there obtained can be readily constructed. The accompanying diagram (fig XI) represents a simple instrument which the writer has invented for this purpose and used in his classes for the last four years. It is adapted only to black-board work, but an instrument suitable for drafting purposes could be made on the same principle.

AC is a movable crank, attached to the bars CD and PE.

AC=OC AP.

As AC revolves about C the bar PE, by means of a slot, moves along and turns around a fixed pin at O.

Thus as A describes the directric circle, P describes the outer branch of the limaçon of which CD is the axis.

This particular case of the limaçon possesses many other interesting properties which are in no way connected with the solution of the problem discussed in this paper.

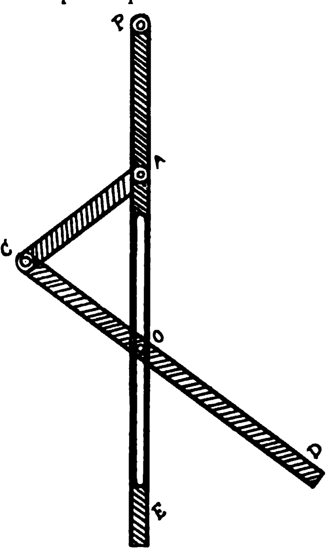


Fig. XI.

New Genera and Species of Psilopinæ.

BY J. M. ALDRICH.

The genus *Psilopus* has heretofore occupied a place apart in the family Dolichopodidae. Notwithstanding the immense number of species, comprising some ninety in America alone (if we may trust the descriptions), no acceptable plan of dividing the genus has yet been proposed. Bigot's attempt (Ann. Soc. Ent. Fr., Oct., 1890, p. 268) is the latest. His high estimate of the value of the antennal modifications has led him to overlook other characters, and select, in two instance, a nodule or disk on the arista of the male antenna as the basis of a new genus. This is too slight a character for the purpose. The apical or dorsal insertion of the arista, which he uses to separate two groups of genera, would, if well-marked, be important; but when it is necessary to explain at some length just how far up from the apex the arista may be and yet be "apical or subapical," the value of the distinction sinks into insignificance.

Loew (Mon. N. A. Dipt. II, 231) suggested that the color of the tegular cilia seemed to offer the best ground for division of the genus. In the line of his proposition, I have found that these cilia, when black, are associated with four large bristles on the scutellum, and a third longitudinal vein of the wing which curves backward at the tip in the normal manner. When they are pale, the scutellum has only two large and usually two small bristles, and the third vein near its tip is distinctly curved forward, parallel or nearly so with the branch of the fourth vein. Thus we find ample ground in three distinct characters, applicable to both sexes, for the division of the genus. In an examination of about thirty species, these characters apply perfectly to all but one: in this, a South American species, the curved vein is associated with four large scutellar bristles and the tegular cilia are half pale and half black. This species I would include among those with black cilia.

Adding to these two genera two more which are new to science, described in this paper, we have the section Psilopinae of the family Dolichopodidae thus characterized:

Fourth longitudinal vein with a widely divergent fork on the front side; or if not, then the head wider than the thorax, face wide, and the front deeply excavated.

GENERA OF PSILOPINAE.

1. Fourth longitudinal vein not forked, *Aptorthus*, n. gen.
Fourth vein forked. 2.
2. Tegular cilia black, third vein gently curved back at tip, scutellum with four large bristles, *Psilopus* Meigen.
Tegular cilia pale, third vein distinctly curved forward at the tip, scutellum with only two large, and usually also two small, bristles. 3.
3. Face wide, front deeply excavated, *Gnamptopsilopus*, n. gen.
4. Face narrow, front scarcely excavated, *Leptorthethrum*, n. gen.

The name *Psilopus* is preoccupied in the Mollusca, as Osten Sacken and others have mentioned. A new name should not be proposed for the dipterous genus without a careful examination of several of the older European works, which are inaccessible to me. It is probable that, as Bigot suggests, *Psilopodius* Rondani is the legitimate successor of the old name.

GNAMPTOPSILOPUS n. gen.

(*gnamptos*, bent).

Includes all that part of the old genus *Psilopus* in which the species have pale tegular cilia. Other characters are as above mentioned. *Psilopus scintillans* Lw., *bicolor* Lw., *tener* Lw., and *filipes* Lw., are typical species.

APTORTHUS n. gen.

(*a*, without: *ptorthos*, branch).

Structure of the head as in *Psilopus*, front very deeply excavated. Posterior crossvein shorter and less oblique than in *Psilopus*, its anterior end nearer the middle of the wing; fourth vein with a rounded but rather short curve forward, at a distance beyond the crossvein equal to the length of the latter; beyond this curve gradually retiring to its former course, so that the first posterior cell has a long, slender, gently narrowed tip; the end of the fourth vein is before the apex.

Aptorthus albiciliatus n. sp.

Male. Face broad, with thin yellow pollen; front shining green, the two ocellar bristles black, a bunch of bristles behind these and another on each side next the orbit yellowish; antennae small, black, the arista dorsal, rather short, the hairs of the second joint of the antenna yellow; palpi and proboscis pale; cilia of the inferior orbit white, rather bushy. Thorax shining blue-green, with black bristles; pleurae slightly white dusted; tegula white, its tip black, with long whitish-yellow cilia; halteres yellow, the peduncle brownish; scutellum with four bristles, the inner pair somewhat larger than the outer. Abdomen shining blue-green, with rather thick and coarse hair, which is black at the base and somewhat rusty, or in some lights yellowish,

before the tip; on each side of the first segment a bunch of long yellow hairs; hypopygium black, closely folded up to the venter, the small apical organs yellow. Coxae green; the fore and middle ones with long white hairs on the front side; trochanters yellow; femora green, rather broadly yellow at the tips, with white hairs, longer below, especially on the middle and hind femora; fore and middle tibiae yellow, the hind ones brownish-yellow; all the tarsi gradually infuscated toward the tip; the fore and middle tarsi are considerably, the hind ones scarcely, longer than their tibiae. Wings hyaline, the venation as described.

Female. Pollen of face white, lateral bunches of hair on the front brownish-black, the central bunch very short, whitish; hairs of the second antennal joint rather short, brown; abdomen with shorter hairs, lacking the white ones on the first segment; femora and hind tibiae wholly yellow, the former with short hair.

Length, 4 mm.; of wing, 3.5 mm.

Two males and two females, Westville, N. J., July 5 and 20 (C. W. Johnson).

Aptorthus borealis n. sp.

Female. Differs from the female of the preceding in having yellow fore coxae, brownish at base; on each side of the front near the eye are only a few small black bristles.

One female, Ramsey Co., Minn. (Lugger).

Aptorthus nigripes n. sp.

Female. Face white-dusted; palpi and proboscis brown; antennae black, second joint with black or dark brown hairs; front shining green, the two bristles of the ocellar tubercle black, behind the tubercle a cluster of small, white ones; on each side next the eye are a few white bristles and two black ones farther forward. Cilia of inferior orbit white. Thoracic dorsum shining blue-green; pleurae blackish-green, with white dust; tegulae white with a narrow black edge and long white cilia; halteres yellow, abdomen blue-green, shining, with black hairs, which are mixed with a few paler ones at the sides near the base. Coxae blackish-green, with conspicuous white hairs. Femora of the same color, with black hairs except on the lower edge, where the hairs are pale and rather short; knees yellow; fore tibiae brownish-yellow, the middle and hind ones, with their tarsi, brown. Fore tarsi brownish-yellow at base, darker toward the tip. Wings hyaline, venation as above described for the genus.

Length, 4 mm.; of wing, 3.5 mm.

One female, California, Aug. 5 (Coquillett).

Apthorthus townsendii n. sp.

Female. Face thinly dusted with white; front bright green, ocellar bristles yellow, the cluster just behind these minute, white; bristles of the sides of the front yellow; antennae black, hairs of second joint brown; cilia of inferior orbit white, thorax bright green with à thin coat of white dust, especially about the edges, the bristles long and strong, brownish yellow in color, those of the central dorsal region more blackish. Pleurae green, with whitish dust; halteres and tegulae as in *nigripes;* scutellum with a large and a small pair of yellow bristles. Abdomen golden green, with short yellow hairs all over its dorsal surface. Fore coxae yellow with coarse yellowish-white hairs; middle and hind coxae black, with yellow tips and white hairs; femora, tibiae and tarsi yellow, the last toward the tip blackened, especially the hind ones. The hairs of the legs are few, short and pale. Wings hyaline, venation as above.

One female, Aztec, Arizona, July 21 (Townsend).

Length, 4 mm.; of wing, 3.5 mm.

LEPTORHETHUM n. gen.

(*leptos*, narrow; *rhethos*, face).

Head wider than thorax; face long, narrow; antennae as in *Psilopus*, arista dorsal; front scarcely at all excavated, the lateral bristles small, acrostichal bristles in two rows; scutellum with a large inner and a small outer pair of bristles. Abdomen of male somewhat clavate, the hypopygium sessile, but little visible. Wings narrowed at base, sixth vein absent; third longitudinal vein curved forward at the tip; fourth vein forked as in *Psilopus*.

Leptorhethum angustatum n. sp.

Male. Antennae, proboscis, coxae and legs yellow; cilia of tegulae yellow; eyes almost contiguous on the middle of the face. thorax bright green above; abdomen green, venter and basal segments largely yellow.

Length, 2 mm.; of wing, 2.2 mm.

One male, St. Vincent, West Indies (H. H. Smith).

A fuller description of this species will appear in an extensive paper on the West Indian Diptera now in preparation.

PLATE I.

GENUS DOLICHOPUS.

Fore tarsi of males, side view.

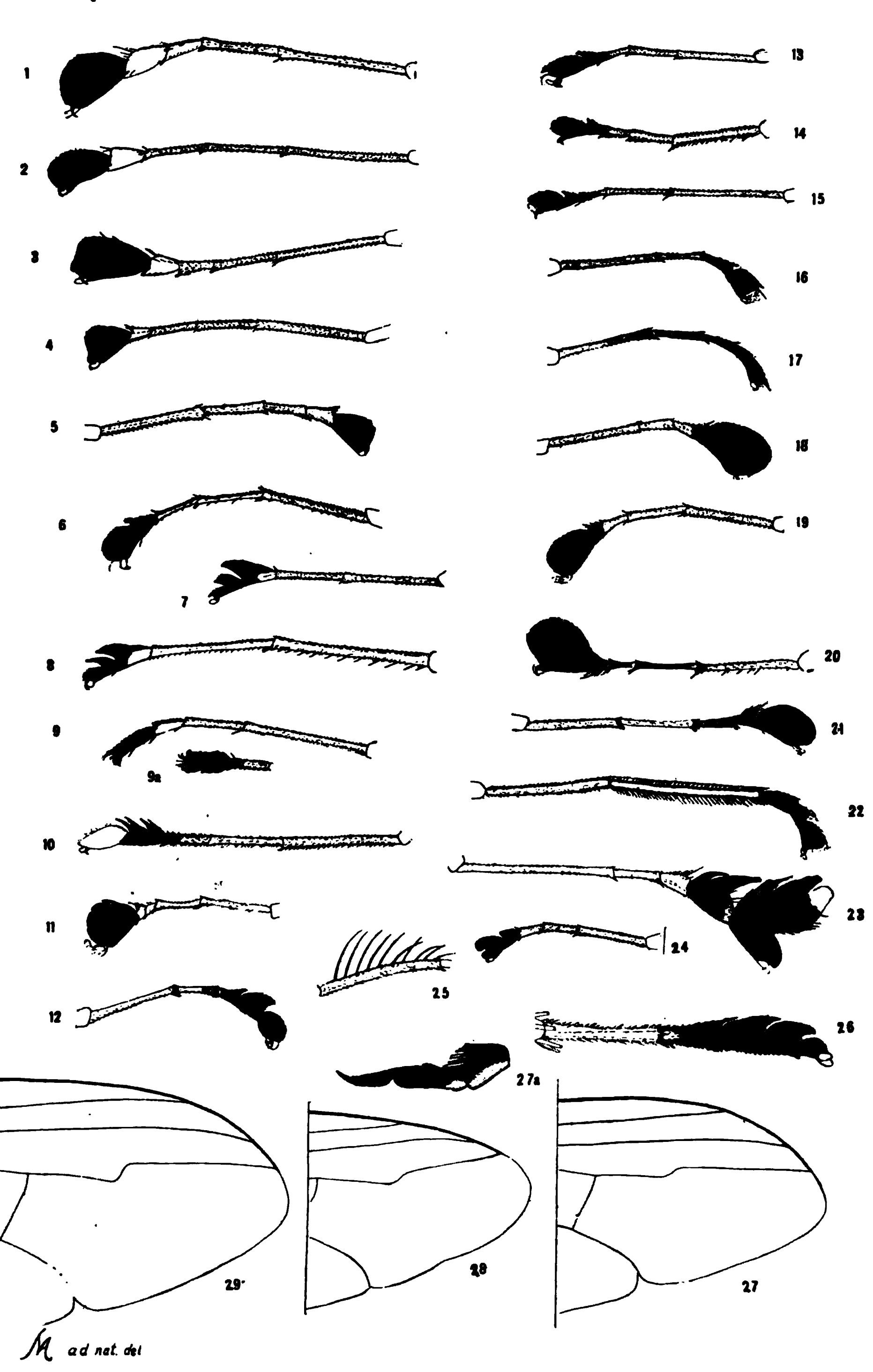
Fig. 1. *dakotensis* n. sp.
Fig. 2. *edactyls* Loew.
Fig. 3. *palæstricus* Loew.
Fig. 4. *angustatus* n. sp.
Fig. 5. *splendidus* Loew.
Fig. 6. *brevipennis* Meigen.
Fig. 7. *cuprins* Wiedeman.
Fig. 8. *longipennis* Loew.
Fig. 9. *scoparius* Loew.
Fig. 9a. *scoparius* Loew, last three joints from above.
Fig. 10. *funditor* Loew.
Fig. 11. *flagellitenens* Wheeler.
Fig. 12. *pachycnemus* Loew.
Fig. 13. *albicoxa* n. sp.
Fig. 14. *bifractus* Loew.
Fig. 15. *vigilans* n. sp.
Fig. 16. *plumosus* n. sp.
Fig. 17. *coquilletti* n. sp.
Fig. 18. *occidentalis* n. sp.
Fig. 19. *agilis* n. sp.
Fig. 20. *lobatus* Loew.
Fig. 21. *duplicatus* n. sp.
Fig. 22. *grandis* n. sp.
Fig. 23. *willistonii* n. sp.
Fig. 24. *obcordatus* n. sp.

Middle metatarsus of male, side view.

Fig. 25. *comatus* Loew.

GENUS HYGROCELEUTHUS.

Fig. 26. *latipes*, middle tarsus of male.
Fig. 27. *crenatus* O. S. tip of wing.
Fig. 27a. *crenatus* var., male antenna, inner side.
Fig. 28. *ciliatus* n. sp., tip of wing.
Fig. 29. *afflictus* Osten Sacken, tip of wing.



J. M. Aldrich, ad. nat. del.

PROSPECTUS.

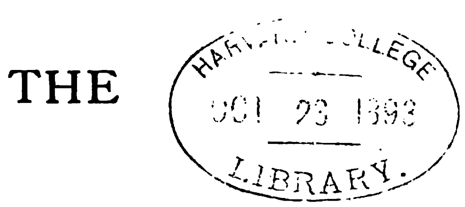
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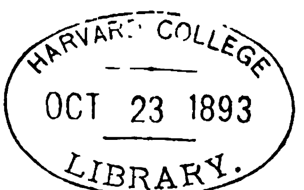
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KANSAS UNIVERSITY QUARTERLY.

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The Sclerites of the Head of *Danais arch-*

ERRATA

P. 55, at top, for: see *la*, read. see [illegible] continuity of the mandibles with the [illegible] read, continuity of these processes [illegible] the mandibles are present—.

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Eyes.

Of the fixed parts of the head of *archippus* the compound eyes are conspicuously large, each one constituting about one-third of the head (see *eye* in fig. 11, Plate II). There are no ocelli.

Clypeus.

The rounding, tumid clypeus makes up the larger part of the front aspect of the head (see *cl* in fig. 11, Plate II). The clypeus extends upward to the antennary fossæ, and as a short, broad tongue between them to a suture running transversely from fossa to fossa. This suture is plainly apparent in simply †denuded specimens or in ‡bleached specimens. In this point, as well as in a few others, my

*Kellogg, Vernon L., Notes on the Elementary Comparative Anatomy of Insects. 1892, Lawrence, Kas.

†Rubbing with a soft, pointed brush, assisted by gentle manipulation with a needle or delicate forceps will soon denude the head of its scales.

‡I find the most satisfactory method of bleaching the heads to be this: boil for a few minutes in potassium hydrate until the eyes become light-brown; then wash, and transfer to eau de Labarraque, in which fluid the head will soon reach the desired clearness.

observations lead me to contradict statements in Mr. Edward Burgess's *memoir on the anatomy of *archippus*.

This suture in the head of *archippus* is shown as *su* in fig. 11, Plate II. This suture was apparent in all of the few lepidopterous heads examined by me, except in specimens belonging to the genus Hepialus. It is shown as it appears in *Protoparce carolina* at *su* in fig. 2, Plate II; in *Argynnis cybele* at *su* in fig. 5, Plate II; in an exotic Hesperid butterfly at *su* in fig. 4, Plate II; in *Hemaris thysbe* at *su* in fig. 12, Plate II. It extends uniformly from fossa to fossa. In *Actias luna* it is very short, as the clypeal tongue tapers almost to a point, meeting the similar narrowly pointed, forward-projecting tongue of the epicranium. The clypeus in *archippus* is shield-shaped. The sutures between it and the genæ are fairly distinct, and each one is accompanied in its upper half by a ridge. The lower half of each suture (that part separating the triangular expansion of the gena from the clypeus) is especially distinct, and in bleached specimens appears as a linear space with a noticeable expansion near its point of intersection with the sutural ridge above mentioned. This also is the case in the heads of certain other lepidoptera (see in *Argynnis* fig. 5, Plate II, and in an exotic Hesperid, fig. 4, Plate II). In *Protoparce carolina* only the lower portion of each suture is distinct, though a well defined ridge separates the two sclerites above. In *Triptogon modesta* the clypeus apparently extends quite to the eye on each side.

Genæ.

Between the clypeus and the eyes are the narrow, elongate genæ. They compose the front portion and part of the upper and lower portions of the orbits of the eyes (see *ge* in fig. 11, Plate II). Each gena presents a triangular expanded portion lying between the base of the maxillar proboscis and the lower inner angle of the eye. *Triptogon modesta* seems to have no elongate portion extending upward from the triangular expansion, the clypeus apparently extending laterally to the eyes. The gena in *archippus* bounds the antennary fossa outwardly, and extends up and back to the post-gena. In *archippus* the suture between gena and post-gena is obsolete (see fig. 9, Plate II), but it is distinct in most Lepidoptera (see su^1 in fig. 1, Plate II, *Protoparce carolina; su*^{1} in fig. 3, Plate II, *Pamphila leonardus; su*^{1} in fig. 6, Plate II, *Actias luna*). The suture between the epicranium and that part of the gena lying behind the antennary fossa is obsolete in *archippus* (see fig. 9, Plate II). This suture is usually present in the lepidopterous head (see *su*'' in fig. 1, Plate II, *Protoparce caro-*

*Burgess, Edw., Contributions to the Anatomy of the Milk-weed Butterfly, *Danais archippus* Fab. 1880. Boston. Mr. Burgess says: "The face includes the region below the antennæ, and is formed chiefly by the large vaulted clypeus, whose arc-shaped lateral boundaries are well marked, while above it passes directly into the epicranium without any suture or line of demarcation as found in many insects."

lina; su'' in fig. 3, Plate II, *Pamphila leonardus; su''* in fig. 6, Plate II, *Actias luna*). The aborted mandibles, where I have observed them present among lepidoptera, articulate or fuse with the genae (see *md* in fig. 2, Plate II, *Protoparce carolina;* and *md* in fig. 12, Plate II, *Hemaris thysbe*). In *archippus* the mandibles are entirely wanting* (see fig. 11, Plate II).

Epicranium.

The dorsal aspect of the head of *archippus* and the middle upper part of the hind aspect are composed of the epicranium, a sub-oblongate sclerite with its bounding sutures largely obsolete (see *ep* in figs. 9 and 11, Plate II). A short, broad tongue projects forward between the antennae meeting the backward-projecting tongue of the clypeus, and distinctly set off from it by the short transverse suture extending from fossa to fossa. The epicranium presents a tumid transverse space on the hind aspect of the head, ending in two tumid whitish spots (in simply denuded specimens). The suture between epicranium and occiput is fairly distinct. The epicranium varies considerably in shape in lepidoptera; in *Actias luna* it is triangular in outline and relatively small (see *ep* in fig. 6, Plate II). The suture between it and the occiput is usually sub-obsolete, as in *Pamphila leonardus* (see *ep* in fig. 3, Plate II). In *Hepialus montanus* and in other specimens examined a faint median longitudinal line dividing the epicranium into two portions, or "epicranial plates," can be seen.

Occiput.

In *archippus* the occiput is a small narrowly oval sclerite bounding the upper margin of the occipital foramen (see *oc* in fig. 9, Plate II). It is fairly distinct from the epicranium, which is perhaps not usually the case among lepidoptera. It is some times a very narrow transverse sclerite, as in *Actias luna* (see *oc* in fig. 6, Plate II); or again it may be sub-triangular with rounding apex and base, as in *Protoparce carolina* (see *oc* in fig. 1, Plate II). It is usually slightly tumid in its central portion.

Post-genae.

This name may be applied to two important sclerites, constituting the posterior portions of the orbits of the eyes, and also the lateral portions of the hind aspect of the head (see *p-g* in fig. 9, Plate II). These sclerites are called post-genae by †Prof. J. H. Comstock and correspond to the "tempora" of ‡Kirby and Spence, and to "*les*

*I do not believe that the minute projections at the base of the proboscis in *archippus* and usually called mandibles, are such. (See "Labrum," *postea.*)

†Comstock, J. H., MS.

‡Kirby and Spence. Introduction to Entomology, vol. 3, p. 488. 1828. London.

tempes" of *Lacordaire. Post-genae seems to me quite the preferable name because of the relation of these sclerites to their counterparts of the front of the head (the genae). In *archippus* the post-genae are large, and are only indistinctly set off from the epicranium and genae, as explained under "Genae," and "Epicranium," *antea*. In most lepidoptera, however, these limiting sutures are distinct (see *su'''* in figs. 1 and 3, Plate II; see also references to species and drawings under "Genae," and "Epicranium," *antea*). The post-genae extend in on each side to the occipital foramen, and often (perhaps always in carefully handled specimens) appear to be connected by a sub-transparent transverse bar running across the foramen. This bar is a portion of the tentorium of Burmeister, or "internal skeleton" of the head (see *tent* in fig. 9, Plate II). The post-genae extend upward and forward till they meet the genae; and they extend downward and forward till they meet the other ends of the genae. This meeting place is usually, among lepidoptera, about opposite the insertions of the labial palpi, and the suture between genae and post-genae can usually be distinguished with difficulty. This suture is plain in *Protoparce carolina* and indistinct in *archippus*.

Gula.

The gula is distinguishable in *archippus*, if at all, with difficulty. That part of the external cranial skeleton bounding the occipital foramen below should belong to the gula; but where I have examined this region in *archippus*, the lower boundary of the foramen appeared to consist of a portion of the tentorium or internal skeleton of the head (see *gu* in fig. 9, Plate II); and this portion seemed intimately united with the basal part of the labium. In other lepidopterous forms a gula, intimately united with the labium, appears to be present. An elevated line or ridge often seems to indicate the probable position of the obsolete suture between the two sclerites, as in *Triptogon modesta* (see *gu* in fig. 7, Plate II), and in *Catocala* sp. (see *gu* in fig. 13, Plate II).

THE MOVABLE PARTS.

Antennae.

I have nothing to add to the familiar characters of the antennae.

Labrum.

The labrum presents an interesting condition in *archippus*, as, indeed, it does in the lepidoptera generally. It is a narrow, trans-

*Lacordaire, Th., Introduction a l'Entomologie, p. 257. 1834. Paris. This reference to "les tempes (tempora)" seems to be translated almost literally from Kirby and Spence's Introduction (see foot-note reference).

verse sclerite, fixed, and usually plainly distinguished from the clypeus (see *la* in fig. 11, Plate II). It bears uniformly, as far as I have observed, two tapering, forward-projecting points, rising from the ends of the transverse portion of the sclerite (see *pf* in fig. 11, Plate II). These points bear on their inner margins a row of short, bristly hairs, which are usually of light-brown color. These colored hairs, indeed, will often lead to the detection of the projections which otherwise might remain unnoticed. These hair-bearing labral projections are the points designated as mandibles by *Burgess in his memoir on *archippus*. Probably the first description of these processes as mandibles is that by Savigny (1816) in the following words: "Les mandibules sont d'une exigueté proportionée à celle de la lèvre supérieure. Dans la plupart des espèces elles paraissent à la loupe beaucoup moins grandes que les écailles qui couvrent le chaperon; elles sont appuyées sur les deux côtés de la trompe, et trop écartées pour pouvoir se toucher par leur sommet. Leur mouvement est assez obscur et dans certains genres, comme dans les *Sphinx* elles paraissent plutôt soudées au chaperon qu' articulées; d'autrefois elles font corps avec le base de la lèvre supérieure; elles sont d'ailleurs cornées, très lisses dessus et dessous, vides au dedans, tantôt applaties, tantôt renflées, plus ou moins coniques; divergentes, parallèles ou convergentes; pointues ou obtuses, suivant les genres, mais dans tous bordées de cils très-épais sur leur tranchant interieur." I think there is no doubt of the continuity of the mandibles with the labral sclerite. When present in lepidoptera they articulate or fuse with the genae (so far as I have observed), and the labral projections, which I suggest may be known as the †pilifers, are to be found in a specimen along with mandibles, but distinct from them. This is plainly shown in *Protoparce carolina*, where the rather conspicuous mandibles plainly arise from the genae, showing a faint suture of articulation, and being strongly chitinized at the tooth-like tips. The pilifers are large, and are manifestly distinct‡ from the mandibles (see *md* and *pf* in fig. 2, Plate II). In *Hemaris thysbe* the suture between the mandibles and gena is obsolete, and the mandible appears as a strongly-chitinized, brown-pointed projection of the gena. The pilifers, evidently processes of the labral sclerite, are present (see *md*

*Burgess, Edw. *Loc. cit.*

†With the scanty means of reference at my command I may be unaware of a previously suggested name for these processes.

‡On this point Newport says in his article "Insecta" in Todd's Cyclopedia of Anatomy and Physiology (1836-39), discussing the mouth-parts of *Sphinx ligustri*: "On each side of the labrum are the rudiments of the mandibles. They are two minute triangular plates, attached in part to the labrum and margin of the clypeus, to which as Savigny has remarked they appear to be soldered. They are applied to the base of the maxilla, and in *Sphinx* appear each to be formed of two parts, and are covered along their margin with stiff hairs." It is the outer one of the "two parts" which I take to be the mandibular remnant and the inner one, the pilifer.

and *pf* in fig. 12, Plate II). Nor can the pilifers be construed to be the maxillary palpi, for in addition to the fact of their identity with the labrum, the maxillary palpi when present in lepidoptera, are found in specimens along with, but distinct from the pilifers. The palpi arise also from the immovable basal portions of the maxillae (see *mxp* and *pf* in figs. 13 and 14, Plate II, *Catocala* sp.). There is in *archippus* and in lepidoptera generally, a very small triangular piece projecting forward from the labrum (see *epx* in fig. 11, Plate II). This piece is called epipharynx in *Lang's discussion of the Antennata in his Text-book of Comparative Anatomy.

Mandibles.

The mandibles are wanting in *archippus*. They are present in an aborted condition in many lepidoptera. The mandibles have been discussed under "Labrum" *antea*.

Maxillae.

The characteristic, long, coiling, sucking tube of the lepidoptera is composed of the greatly extended, opposed terminal portions of the maxillae. In addition there is a fixed basal portion of each maxilla, which cannot be divided into cardo and stipes. In *archippus* the basal portion extends backwards and downwards partially bounding a cavity lying between it and the labium (see *mx-b* in fig. 8, Plate II). The basal portion is shining brown. The maxillary palpi when present arise from this fixed basal portion as in *Catocala* sp. (see *mxp* and *mx-b*. in figs. 13 and 14, Plate II). †Burgess refers to two minute tubercular points on the proboscis of *archippus* and an appreciable distance from its base as the remnants of the maxillary palpi. This does not seem reasonable. For the proboscis is probably composed of one or both of the terminal plates (galea, lacinia) of the more generalized maxilla, and the fixed portion is probably composed of one or both of the basal sclerites (stipes, cardo) of the more generalized maxilla. In generalized maxillae the palpi arise from the stipes.‡ By homology we should expect to find the palpus in lepidoptera arising from the fixed basal portion, which, as above stated, is precisely the condition that is presented in *Catocala* and in those lower moths possessing distinct maxillary palpi.

In *archippus* the proboscis is long and composed of parts of both maxillae (see *mx* in figs. 8 and 11, Plate II). In some lepidoptera, however, the maxillar extensions are distinct, either as stiff blade-like

*Lang. Arnold. Text-book of Comparative Anatomy. (Trans. Bernard.) 1891. London
†Burgess. Edw. *Loc. cit.*
‡Strictly, perhaps, the palpi arise from the palpus-bearer which joins the stipes.

pieces, or as flexible tube-like processes, as in *Triptogon modesta* (see *mx* in fig. 7, Plate II).

Labium.

The labium of *archippus* is a fixed, semi-membranous sclerite, triangular in outline, with its apex projecting forward and joining the maxillar proboscis at its origin (see *lm* in fig. 8, Plate II). This intimate union of the labium and maxillae is manifest in all of the few lepidopterous heads I have examined. The well-known labial palpi arise from the base of the triangular labium (see *l. p.* in fig. 8, Plate II). The labium largely forms the floor of the head, and while not at all uniform in outline among lepidoptera, well retains its general character of a fixed, more or less membranous sclerite (see *lm* in fig. 7, Plate II, *Triptogon modesta*; also *lm* in fig. 13, Plate II, *Catocala* sp.).

The drawings for the plate accompanying this paper were made by Miss Mary Wellman, to whom I am indebted for critical assistance.

New or Little-known Diptera.

BY S. W. WILLISTON.

Platyura pulchra, n. sp.

Male. Antennae about as long as the thorax; black, on the under side, toward the base, red; first two joints yellow. Front and face black, the latter with whitish pubescence; palpi and proboscis yellow; occiput black; epistoma moderately projecting. Mesonotum shining reddish yellow, with light-yellow hair; three dark brown stripes, separated by slender lines, the lateral ones abbreviated in front. Scutellum black. Pleurae black, with reddish spots; the projecting metapleurae yellowish. First two segments of the abdomen black; third segment reddish yellow, with a black hind border; fourth segment and the anterior part of the fifth reddish yellow; remaining segments black; the hypopygium reddish, with whitish pubescence; abdomen shining. Coxae and legs (the hind pair is wanting) light yellow; tibiae infuscated by the minute black hair; tarsi blackish; middle and front tibiae with short spinules. Wings hyaline, the tip and posterior border infuscated; a narrow brown cloud covers the tip of the first vein and reaches into the base of the first posterior cell; subcostal cross-vein only a little distance beyond the humeral cross-vein; tip of auxiliary vein beyond the origin of the third vein; the anterior branch of the third vein terminates in the first vein near its tip; prefurca of fourth vein very short; seventh vein complete.

Length, 8-9 mm.

One specimen, Washington, University of Kansas.

Platyura notabilis, n. sp.

Male. Antennae black, not compressed, a half longer than the thorax; first two joints yellow. Face and lower part of the front reddish yellow; epistoma projecting, beak-like; palpi and proboscis yellowish; front, except the lowermost portion, black. Thorax yellow, the mesonotum somewhat reddish; a blackish spot on the proximal part of the hind coxae and the adjacent portion of the pleurae; a fringe of black hairs just above the root of the wings. Abdomen reddish yellow, with short, black hair. Legs yellow, the tibiae and tarsi infuscated or blackish; front tibiae bare, the middle and hind pairs with short spinules. Wings yellowish, the tip infuscated; a feebly marked brownish band before the tip; the auxiliary vein terminates at

the origin of the third vein; the anterior branch of the third vein joins the costa just beyond the insertion of the first vein; seventh vein complete.

Length, 8 mm.

One specimen, Washington, University of Kansas.

Platyura gracilis, n. sp.

Male. Antennae black, much shorter than the thorax; first two joints yellowish. Head yellow, the vertex blackish. Thorax, coxae and femora yellow; the mesonotum more reddish, with a fringe of black hairs above the root of the wings. Abdomen slender, not shining; yellow, the anterior portion of each segment brown or blackish. Tibiae somewhat infuscated by the minute black hairs; tarsi blackish. Wings with a strong yellow or brownish tinge, the extremity with a blackish cloud; auxiliary vein very short, terminating before the origin of the third, the subcostal vein at about its middle; anterior branch of the third vein at some distance before the tip of the first; seventh vein wholly wanting.

Length, 6 mm.

One specimen, Washington, University of Kansas.

Neoglaphyroptera striata, n. sp.

Male. Head yellow, the occiput somewhat brownish; antennae brown, the basal joints yellow. Thorax yellow; mesonotum with four brown stripes, the median ones narrower, narrowed posteriorly and separated by a slender line, the lateral ones abbreviated in front; metanotum brown; bristles of the mesonotum well developed, as are also those of the trichostical row. Abdomen black, the anterior part of the segments yellow or brown. Legs yellow; tip of the hind femora and tibiae and all the tarsi brown; front metatarsi as long as the tibiae; middle and hind tibiae with bristles on the outer side. Wings yellowish hyaline; an irregular brown band across the outer part, and brown spots on the cross-veins and on the sixth vein; seventh vein incomplete; the auxiliary vein terminates about opposite the furcation of the fifth and sixth veins, and the subcostal cross-vein is situated beyond its middle; anterior cross-vein longer than the last section of the first vein.

Length, 5 mm.

One specimen, Washington, University of Kansas.

Limnobia concinna, n. sp.

Male. Head and palpi deep brown or blackish, the rostrum more reddish; occiput and vertex grayish dusted. Antennae deep brown, the basal joints scarcely at all reddish. Thorax deep brown, gray

pollinose, leaving on the mesonotum two median stripes, separated by a line, and, on either side, oval spots of a dark coffee-brown. Abdomen deep brown, lightly pruinose; genitals reddish. Legs brown, the base of the femora yellowish; all the femora with a narrow, light-yellow band before the tip. Wings whitish hyaline, with numerous, dark brown, rounded spots, and with clouds on the cross-veins; along the costa, four elongated brown spots, with narrow, hyaline intervals between them; tip of the auxiliary vein a little before the middle of the prefurca; marginal cross-vein at the tip of the first vein.

Length, 9-10 mm.

Three specimens, Washington, University of Kansas.

Limnobia cinctipes Say.

Two specimens from Washington agree with the description of this species.

Eriocera obscura, n. sp.

Female. Black or deep brown, gray pollinose. First joint of the palpi short, the second nearly as long as the two following together, third and fourth a little thickened, the fourth incurved. Antennae brown, sometimes yellowish, scarcely twice the length of the head; first joint thickened; second joint globular; third joint slender, cylindrical, as long as the next three joints together; fifth, sixth and seventh joints slender, of nearly equal length; the antennae are clothed with short, black hairs. Halteres light yellow; under process of the short ovipositor light yellow at the tip. Legs obscure yellowish; tip of femora, tibiae, and the tarsal joints brown. Wings sub-hyaline, with distinct blackish clouds on all the cross-veins and on the outer end of the posterior veins; the auxiliary vein terminates in the costa a short distance before the origin of the second vein; the second vein arises before the middle of the wing, rectangularly, and has a considerable stump of a vein; the marginal cross-vein unites with the second vein at its furcation, a short distance before the tip of the second vein; prefurca of the second vein as long as the posterior side of the discal cell.

Length, 9-10 mm.

Five specimens, Washington and California. In two of the specimens, the mesonotum is clothed with light yellowish hair; in the others, with short, black, more bristly hairs. In two or three there is a marked tendency to irregular cross-veins.

Eriocera eriophora, n. sp.

Male. Head brownish red, the occiput gray pollinose; pile long, light yellow. Palpi longer than the head; first, second and fourth

joints elongate. Antennae longer than the head and thorax together, brown; fourth joint a little shorter than the third, the fifth and sixth together as long as the preceding joints; the four distal joints with bristles on the under surface. Thorax opaque, light bluish gray, the mesonotum with four brown stripes, of which the lateral ones are abbreviated; pile of the mesonotum like that of the head, abundant. Halteres reddish, the knob brown. Abdomen brownish black, but little shining, with light-colored pile. Legs dark brown; the tibiae, for the greater part, reddish. Wings nearly hyaline; stigma dark brown; first posterior cell a little longer than the first submarginal; five posterior cells; petiole of the second posterior cell twice as long as the cell itself, the cell wanting in one wing of the single specimen.

Female. Antennae about as long as the mesonotum, the bristles of the under side inconspicuous; fourth joint about one-third of the length of the third, the following joints successively shorter; not less than ten-jointed. Color of the pleurae and legs more reddish. Second posterior cell as long as its petiole.

Length, male, 12 mm; with antennae, 20 mm. Length, female, 20 mm.

Two specimens, Washington, University of Kansas. This species is nearest related to *E. spinosa* and *E. californica* of Osten Sacken, but will at once be distinguished by the much shorter antennae.

Rhaphidolabis debilis, n. sp.

Female. Head blackish fuscous, the occiput somewhat grayish; the frontal tubercle small. Antennae and palpi nearly black, the first two joints of the former reddish. Thorax yellow, the pleurae in the middle brownish; mesonotum dark brown with its margins yellowish, the brown separated by two slender, yellowish lines. Halteres brown, yellowish on the proximal part. Abdomen brownish yellow. Legs brownish yellow, the femora yellow on the proximal portion; distal joints of the tarsi blackish; tarsi shorter than the tibiae, the first joint longer than the succeeding four together. Wings with a light brownish tinge; the auxiliary vein terminates a little beyond the great cross-vein; the origin of the second vein is opposite the termination of the seventh vein; marginal cross-vein at some distance from the tip of the first vein; the third vein is branched, not the second, and the petiole of the submarginal cell is as long as the discal cell; petiole of the second posterior cell equal to a half of the length of the discal cell; base of the fourth posterior cell a little beyond the middle of the discal cell. Tibial spurs and the pulvilli distinct.

Length. 9-10 mm.

California. University of Kansas collection.

Pachyrrhina erythrophrys, n. sp.

Male. Black, shining, the posterior orbits and the second, third and fourth abdominal segments, except their margins, orange red. Antennae black, somewhat longer than the thorax, the second and following joints of the flagellum with a distinct enlargement at the base, from which the short verticils arise. A ridge, contiguous with the eyes posteriorly, meeting in the middle just back of the antennae and extending to about the middle of the sides of the head, orange red. Thorax shining black throughout; halteres black. Abdomen shining black; the second, third and fourth segments, except the narrow lateral and posterior margins, orange red; on the venter, the anterior portion of these segments is of the same color. Legs black, with the base of the femora yellow. Wings blackish; second posterior cell sessile.

Length, 13 mm.

One specimen, Manitou Park, Colorado, Prof. F. H. Snow.

Ctenophora angustipennis Loew.

Male. Head and antennae black, the palpi and second and third antennal joints yellow. Antennae about as long as the mesonotum, the pectinations scarcely exceeding the antennal joints in length, of equal length on the inner and outer sides, the twelfth joint with two pairs as in the preceding joints; the first pair on the third joint short and obtuse. Mesonotum yellowish red; the lateral margins and a spot in the middle behind black; the humeral callosity, the pronotum, and a stripe on the upper part of the pleurae, running through the root of the wings, yellow. Scutellum on the sides, the upper part of the metanotum, and the metapleurae in front of the halteres, yellow; scutellum and pleurae, otherwise, black. Abdomen yellowish red, with a continuous black stripe, expanded on the posterior part of each segment. Legs yellow; the extremity of the femora and tibiae, and the distal three or four joints of the tarsi, dark brown. Wings light amber-colored.

Length, 17-20 mm.

Two specimens, Washington, University of Kansas.

Ctenophora similis, n. sp.

Male. Resembles *C. angustipennis*, but differs in the mesonotum being shining black, except the small humeral callosities; in the black of the abdomen being more extensive, and in the greater infuscation of the legs.

Length, 19-21 mm.

Two specimens, Washington, University of Kansas. The black of the abdominal segments extends outwardly on the posterior part, so

that the abdomen may be described as black, with a more or less elongated yellowish red spot in each side of the segments, toward the front. The first segment is black, with a light yellow anterior margin.

Stygeropis bergrothi, n. sp.

Male. Black, grayish dusted, with light colored pile. Antennae about as long as the mesonotum, the basal joints slightly reddish. Rostrum one-half the length of the head; occiput thickly gray dusted. Thorax and abdomen uniform in color, and wholly opaque; a slender dorsopleural line, the minute humeral callosities and the sides of the scutellum, yellow or yellowish; forceps of hypopygium yellow; stem of halteres yellowish, the knob black. The slightly thickened distal end of the femora, the tibiae in large part, and all of the tarsi dark brown; femora elsewhere reddish yellow; the basal portion of the tibiae brown; tarsi longer than the tibiae, the metatarsi nearly twice the length of the remaining joints together. Wings uniformly subinfuscated.

Length, 12 mm.

One specimen, Alaska, University of Kansas.

Lordotus pulchrissimus, n. sp.

Female. Black, almost wholly concealed beneath dense and long, bright yellow pile, that of the pectus and base of femora white. Face and front in ground-color opaque, grayish white, the pile more whitish below. Antennae black, the second joint yellow; third joint shorter than the first two together, the second a little shorter than the first. Proboscis nearly as long as the front femora and tibiae together. Thorax and scutellum opaque, the latter convex, without groove or impression. No stripes visible on the mesonotum. Abdomen shining, the covering composed wholly of long and dense pile, uniform in color. Legs light yellow, the tarsi black or blackish; bristles of the tibiae black; pile and tomentum of the femora white. Wings pure hyaline.

Length, 13-15 mm.

Two specimens, Reno, Nevada (Hillman).

Lordotus puella, n. sp.

Male. Black, clothed throughout with grayish yellow pile. Legs black. First two joints of the antennae together a little shorter than the third, the second joint but little longer than broad. Abdomen a little shining beneath the pile; without tomentum. Tibiae slighty reddish. Wings nearly hyaline, the costal and subcostal cells yellow.

Length, 11-12 mm.

One specimen, California (Baron).

Eclimus muricatus.

?*Epibatus muricates* Osten Sacken, Western Diptera, 272.

Female. Wholly deep black throughout, with black pile and deep brown wings. Face and front wholly shining. First joint of the antennae a little shorter than the third. Anterior part of the dorsum of the thorax subopaque; the posterior part, the scutellum and the abdomen very much shining. Wings deep brown; the interior of the outer cells a little lighter colored.

Length, 14 mm.

Two specimens California, Washington; University of Kansas collection.

It is seen that I do not accept the genus *Epibates* Osten Sacken. The sole differences now known to separate it from *Eclimus* are the murication of the mesonotum and the denticulate costa, characters found only in the male, as specimens of *E. magnus* O. S. and *E. Sackeni* Burgess prove. Furthermore, if the characters distinguishing *Epibates* are accepted the name must give way to *Thevenemyia* Bigot, a species of which Bigot has recently described from Washington, without showing wherein it differs from *E. Sackeni.*

Eclimus sodalis, n. sp.

Female. Front but little shining, clothed with long, black pile; on the lower part, somewhat pollinose. First joint of the antennae nearly as long as the third, clothed with black pile. Face moderately shining, with black pile. Occiput with abundant, nearly yellow pile. Thorax but little shining, clothed throughout with nearly white pile; scutellum shining, with white pile; first four segments of the abdomen with rather abudant white pile; that at the extremity black. Femora with sparse black pile. Wings brown in the costal, subcostal and first basal cells; a deep cloud on the anterior cross-vein; less distinct clouds on the outer cross-veins, and at the proximal end of the second submarginal cell.

Length, 11-12 mm.

One specimen, Washington, University of Kansas collection.

Eclimus melanosus, n. sp.

Female. Front, face and basal joint of the antennae with black pile; occiput and the underside of the head with white pile. Third joint of the antennae broad, scarcely longer than the first joint. Mesonotum opaque, with loose, nearly white, or yellowish white pile; scutellum shining. Pleurae white pollinose. Abdomen opaque black, the last segment shining; pile loose, white; on the hind margin of the first five segments more recumbent and showing as narrow bands;

pile of the terminal segments longer, black. Wings nearly uniformly dark brown, the cells posteriorly a little lighter colored.

Length, 7-8 mm.

Four specimens, California.

Eclimus lotus, n. sp.

Male. Vertical triangle, face and basal joints of the antennae with black pile; occiput with yellowish white, the mentum with white pile. First joint of the antennae a little shorter than the third. Mesonotum opaque, with erect, dusky white hair and more recumbent, bright yellow, somewhat curly tomentum or pile. Scutellum with long blackish hair and shorter yellow tomentum. Pleurae and pectus densely white pollinose and with white pile. Halteres yellow, the knob brown. Abdomen deep opaque velvety black, with longer white and blackish hair, and short, curly, bright yellow pile. Wings brownish, deeper along the costa; costa finely denticulate. Dorsum of thorax muricate.

Length, 12 mm.

One specimen, California.

Eclimus auratus, n. sp.

Female. Front shining, clothed with black hair and shorter, bright yellow pile; on the lower part, and the sides of the narrow face, when seen from the side, silvery. The rather broad third joint of the antennae as long as the first two together. Occiput with bright yellow, the mentum with white pile. Mesonotum and scutellum shining, clothed with bright yellow hair and pile. Pleurae and coxae densely white pollinose, and with white hair. Abdomen moderately shining, clothed with recumbent, bright yellow pile, intermixed with black on the distal segments. Wings nearly uniformly brown.

Length, 9-10 mm.

Two specimens, Washington.

Cyrtopogon dasyllis, n. sp.

Male. Black, thickly pilose; pile of face wholly black. Abdomen, except the tip, with long, dense, erect, yellow pile. Tarsi red. Wings hyaline; just before the tip a large, deep brown spot. Face and front with long and dense, deep black pile; beard black. First two joints of the antennae black, the third red; style short and thick. Thorax black, thickly black-pilose; dorsum deep opaque brown, on the sides narrowly, and behind, shining. Scutellum thickly black pilose, sub-shining, convex. Abdomen nearly parallel on the sides, shining, but its shape and color largely concealed by the long, erect, yellow pile; the first segment sparingly black pilose on the

sides; the last three segments and the hypopygium with abundant black pile Legs black, black pilose, the coxae with some whitish pile; the tarsi red, the hind tibiae more deeply so. Wings hyaline, with a large black or deep brown spot before the apex, extending across the wing; a narrow cloud along the last section of the fifth vein.

Length, 16-18 mm.

One specimen, Estes Park, Col., August (Prof. F. H. Snow).

This species is strikingly like *C. dasylloides* Will., but differs in the color of the antennae and facial pile, and in the wing-markings.

Orthoneuromyia, gen. nov. (Asilidae).

Front and face narrow, the former not widened above. Ocellar tubercle without bristles. Face only a little convex on the lower part, but little protuberant; thinly clothed, the mystax thin. First two joints of the antennae of nearly equal length, third joint about twice the length of the first two together, rather stout; style small or rudimentary. Scutellum with four bristles, the median, broadly separated pair, erect; the outer ones shorter. Abdomen elongate, of nearly equal width throughout, the segments longitudinally convex; finely punctulate; hypopygium not hidden, with a lateral, slender, curved process, and a median, stouter, likewise curved, organ. Legs stout, the hind metatarsi somewhat thickened; hind tibiae without cilia on the inner side. Dorsum of thorax with three small bristles on each side, one in front of the suture, one just behind it, and the third on the post-alar callus. Marginal cells of the wings widely open; the second vein terminates in the costa a considerable distance beyond the confluence of the first vein by a well-marked curve; veins at the outer ends of the discal and fourth posterior cells parallel, but not in the same straight line, the two veins closing the cells separated by a short section.

The genus has the venation of *Atomosia*, except that the first longitudinal vein runs gradually into the costa, and is not separated from it as in *Atomosia*. In my synopsis of the genera of the Asilidae, as also in the Trans. Amer. Ent. Soc., vol. xi., p. 9, I located our species of *Laphystia* and *Triclis* among the Dasypogoninae, because the marginal cell is not closed, the second vein terminating in the costa at the tip of the first vein. The peculiar course of the two veins, in these genera, as in the present, is not of the Dasypogonid type, but rather of the Laphrid, and, notwithstanding the open cell, they both find their most natural position near *Atomosia*. The present genus differs from both *Triclis* and *Laphystia* in the narrower front, the presence of scutellar bristles, the structure of the hypopygium, etc., as well as in the venation.

Orthoneuromyia modesta, n. sp.

Male. Black throughout, the pulvilli and halteres alone yellow. Front a little shining in the middle, thinly grayish-brownish dusted. Face rather thickly gray dusted, somewhat shining in the middle; pile and mystax white. Dorsum of thorax shining, but mostly concealed beneath golden pubescence. Pleurae densely white pollinose, with two shining spots, the one on the mesopleuræ, the other in front of the metapleuræ. First five segments of the abdomen with a small silvery spot on the hind angles; elsewhere shining; sixth segment a little longer than the fifth, gradually tapering.

Length, 7-8 mm.

One specimen, Smithville, South Dakota (J. M. Aldrich).

Asilus Novae Scotiae.

Asilus Novae Scotiae Macquart, Dipt. Exot., 2 Suppl., 46.

Male, female. Face thickly covered with silvery pollen, on the gibbosity with sparse black and white bristles; in profile the gibbosity not strongly projecting, extending not quite to the middle of the face. Antennae black, the third joint about as long as the first two together, or a little shorter, the bristle as long as the joint. Front more ochraceous pollinose, and, as also the first two joints of the antennae, with black hair. Beard silky white. Thorax densely gray pollinose, the dorsum ochraceous, leaving two median, narrowly separated, dark brown stripes, and two spots on each side, one in front, the other behind the suture; hair of the dorsum short, sparse, black, the bristles long and moderately strong, also black; on the border of the scutellum with two approximated bristles. Abdomen light ochraceous pollinose on the sides and posterior margins, apparent when seen from above, elsewhere more brownish pollinose, but variable in different lights; when seen from behind more shining blackish brown; hair short, sparse, light colored on the sides of the segments; in front of the hind borders, with short white bristles. Legs black, with close-lying, white hair and long black bristles; all the tibiae and metatarsi, except their immediate tip, and the immediate base of the other tarsal joints light yellow; front tibiae, on the outer side, with several conspicuously long bristles; on the inner side with a brownish or blackish stripe, not reaching the base. Wings hyaline; the outer end and the posterior side, reaching as far as the anal cell, but only including its hind border, lightly tinged with blackish.

Length, 15-19 mm.

Twelve specimens, Connecticut.

Asilus sericeus.

Asilus sericeus Say, J., Acad. Phil. iii, 48, 2; Compl. Wr., ii, 63; Wiedemann,

Auss. Zw. Ins., i, 429, 8; Williston, Trans. Amer. Ent. Soc. xi., pl. ii, fig. 10.
Asilus herminius Walker, List. etc., ii, 410 (type compared by Osten Sacken).

Male, female. Face nearly straight in profile, in the male very gently concave below the antennae and thence more gently convex to the oral margin; nearly bare, but in the middle on the lower half and along the oral margin with not abundant light yellow hair; thickly covered with light golden yellow dust. First two joints of the antennae yellow with sparse yellow and black hair, second joint at the tip blackish, third joint black, narrowly yellow at the base; first joint nearly a half longer than the second, third joint slender, a half longer than the first two joints together, bristle short, styliform, not longer than the second joint of the antenna. Front narrowed above, thickly ochraceous pollinose. Occipito-orbital bristles and the beard short, not abundant, light yellow; occiput light golden yellow, the orbits narrowly whitish. Dorsum of thorax and the coxae, especially the front ones in front, golden pollinose; pleurae and posterior coxae reddish brown; dorsum when seen from above with a broad opaque blackish stripe, when seen from behind with two slender black stripes and the intermediate portion brown; bristles short, sparse, black (usually); scutellum with only two on its border. Abdomen slender, reddish brown, light golden pollinose, but variable in different reflections; when seen from behind there is only a posterior cross-band, narrowed in the middle; on the sides of the second segment with a few bristles and hairs, elsewhere the hair is very short, very sparse and all light yellow; hypopygium and ovipositor small. Wings yellow with the veins of the same color, the interior of the cells on the outer and posterior part of the wings blackish, narrowly separated from the veins by a light yellow border. Legs light yellow, with extremely short black hair on the femora and front tibiae in front, giving them a dark tinge; front side of the front and middle femora with a black or blackish spot; the short hair of the tibiae and tarsi yellow, the bristles mostly black.

Length, 22-25 mm.

Numerous specimens, New England States, Pennsylvania, Indiana, Kansas.

Asilus midas.

Asilus midas Brauer, Sitzb. d. k. Acad. d. Wissensch. p. 387, pl. ii, 1885.—Mexico.

"Ganz schwarz, nur die Flügel sind feurig rothgelb, an der Basis dunkler und an der Spitze rauchgrau gesaumt."

A single specimen of this striking species is in the Kansas University collection, captured by Prof. Snow in New Mexico.

Asilus astutus, n. sp.

Male, female. Face broad; in profile very gently convex on the lower half and as gently concave above; densely covered with light yellow pollen; the mystax does not extend one-half of the distance to the antennae; on its upper part composed of sparse black, along the oral margin of light yellow, bristles, sometimes wholly light colored. Antennae black, the first two joints with short light yellow and black hair, the third joint distinctly longer than the first two together; bristle short, style-like, not longer than the first joint. Front pollinose like the face, and with light colored hair, except a few black hairs on the ocelli. Occiput and occipito-orbital bristles light yellow; beard more nearly white, abundant. Ground-color of the thorax black, but densely covered with light ochraceous pollen, the median stripes and usual spots apparent; dorsum clothed in front with very short, sparse, black hair; behind with not very abundant nor long, but moderately stout, chiefly black bristles; about four on the border of the scutellum; the sparse vestiture of the pleurae wholly light colored. Abdomen not slender nor much elongated; densely covered uniformly with light ochraceous pollen and moderately abundant, recumbent, light yellow hair; on each side and in the middle, toward the front of each segment, with a small, oval, brown spot; hypopygium and ovipositor small, red; there are no bristles on the abdomen, except a few short ones on the sides of the second segment. Legs stout, red, but the color obscured beneath abundant, close-lying, whitish hair; the femora, except broadly on the posterior side, the tibiae broadly in front, but not reaching the base, and the tip of all the tarsal joints black; bristles black. Wings distinctly clouded with a blackish tinge, along the veins in the central portion pure hyaline.

Length, 15 mm.

California.

Asilus annulatus, n. sp.

Face in profile with a well-marked gibbosity below the antennae, on the lower part strongly gibbose, thickly covered with yellowish white pollen and on the gibbosity with thin black bristles above, and light yellow ones below. Antennae black, the first two joints with black hair; first joint but little longer than the second, third scarcely longer than the first two together; arista but little more than half the length of the third joint. Front scarcely narrowed above, ochraceous pollinose, with black hair. Occipito-orbital bristles black above; beard white. Occiput thickly yellowish white pollinose. Thorax grayish yellowish pollinose; dorsum with two dark brown stripes. separated by a linear interval and narrowed and coalescent behind; on each side,

when seen from behind, with a large oval spot, narrowly interrupted by the suture, and a small spot behind; bristles moderately long, two on the border of the scutellum; the fan-like row of thin bristles in front of the halteres white. Abdomen rather broad, thickly light ochraceous pollinose, but very variable in different reflections, showing a darker brownish color; before the middle of the second segment and near the front of the two following segments with a transverse row of finely punctulate spots; on the sides of the second segment with a number of white bristles, on the following segments, just in front of the smooth, bare, hind marginal band, with a row of white bristles on each side, becoming successively shorter and extending further inward; hypopygium and ovipositor small, black or yellow. Legs black with fine, close-lying, white hair; a preapical ring on all the femora, the front and middle tibiae, except the tip and a more or less complete ring or spot on the basal third, and the base of the hind tibiae, yellow; the metatarsi, except the tip, and the base of all the joints also yellow. Wings hyaline, veins black; the large part of the marginal and submarginal, all the posterior, discal and anal cells densely microscopically pubescent, giving them, especially at the tip of the wing, a distinct tinge; distal end of first posterior cell not as wide as the end of the second submarginal cell, both branches of the third vein sinuous.

Length, 16-18 mm.

New Hampshire, Massachusetts, Connecticut, South Dakota, and Kansas.

Asilus angustifrons. n. sp.

Male. Face narrow, with a well-marked gibbosity on the lower part, the concavity on the upper part being distinctly one-half of the length of the face; thickly covered with light golden yellow pollen, on the middle of the gibbosity with black, below and along the oral margin with white hair. Antennae black, the first two joints with black hair, the second more than half as long as the first, the third about as long as the first two together; bristle as long as the third joint. Front narrow, clothed with black hair and yellow pollen. Occipito-orbital bristles chiefly white; beard rather abundant, silky white. Thorax covered with dense silvery gray pollen; on the dorsum ochraceous, leaving two dark brown stripes separated by a linear interval and coalescent and narrowed before reaching the scutellum; on each side with two spots separated, by the suture, and behind them a small one; hair of the dorsum short, sparse, black, the bristles moderately long but not stout; scutellum with two approximated bristles; pleurae with white hair and pile. Abdomen black, not densely

clothed with grayish brownish pollen, but variable in different reflections; when seen from behind, the ground-color is apparent, except on the smooth hind border of each segment; pile of the front segments on the sides white, not abundant; in front of the smooth hind borders of the segments on each side there is a row of white bristles, becoming successively shorter and extending more inwards posteriorly; hypopygium shining black. Legs reddish yellow; the femora in front, the tip of the tibiae and all the tarsal joints black. Wings hyaline on the basal portion, with a distinct brownish tinge beyond the basal cells; at the tip tinged with blackish; the submarginal cell from its base and the marginal cell opposite with a distinct brown cloud; the costal and first longitudinal veins distinctly thickened near the tip of the auxiliary vein.

Length, 15-16 mm.

Twelve specimens, Washington. A single rubbed female among them has the black on the femora less extensive, and the wings pure hyaline, except the faint blackish tinge at the tip.

Asilus flavipes, n sp.

Male. Face narrow, thickly covered with white pollen, on the gibbosity above with white black, below with white hair; in profile not very protuberant below, the gibbosity rather more than half of the length of the face, but receding below so that its border is nearly parallel with the outline of the eyes. Antennae black, the second joint at the tip and the base, and some times nearly the whole of the third joint brownish yellow; the first two joints with black hair, the second joint much shorter than the first, the third as long as the first two, narrowed on its outer part, bristle about as long as the joint. Front with black hair, hardly as narrow above as at the base of the antennae. Occipito-orbital bristles black; beard not abundant, white. Thorax densely covered with grayish white pollen; the two median stripes on the dorsum distinctly separated by a gray stripe, on each side the two usual spots and a smaller one behind; clothed in front with moderately long black hair, behind with rather thin but not stout, black, often intermixed with white, bristles; on the margin of the scutellum with four long bristles; vestiture of the pleurae wholly white. Abdomen black, with white hair; rather thinly pollinose, except on the sides and posterior margins which are rather broadly gray pollinose. Legs: front femora with a broad black stripe above, not quite reaching the tip, middle femora with a similar stripe reaching the whole length; hind femora wholly black; front tibiae at the immediate tip brown, middle tibiae at the tip distinctly black, hind tibiae for about the distal fourth black; tarsi black, except the base of the metatarsi; elsewhere the

legs are light yellow; bristles chiefly black, not conspicuous, several long ones on the outer side of the front tibiae. Wings pure hyaline, the distal end only slightly tinged with blackish.

Length, 15-16 mm.

Pennsylvania.

A single male from Connecticut is apparently the same. It is smaller (12 mm.); the pollen of the face is yellow and the hair wholly black; the abdomen is slender, shining black, except the sides and posterior margins; and the hypopygium is rather more slender than usual and directed upward.

Asilus (Neoitamus) distinctus, n. sp.

Male, female. Face narrow, in profile with a short concavity below the antennae, thence gently convex to the oral margin, but receding so that the border is nearly parallel to the border of the eye, the concavity less than half the length of the convexity; covered with light yellow pollen, the black ground-color of the gibbosity showing through somewhat; in the middle of the gibbosity, save a few black hairs at the top, with moderately long, abundant, light yellow hair. Antennae black, the first two joints with black hair; second joint considerably shorter than the first; third joint hardly as long as the first two together, gradually narrowed to the tip, the bristle thickened, shorter than the third joint. Front black, lightly grayish pollinose and with black hair; occipito-orbital bristles fine, hair-like, black; beard not long nor abundant, light yellow; occiput gray pollinose. Thorax black, gray pollinose; dorsum with two moderately broad, black stripes, narrowly separated, and, on each side, a large oval spot in front and behind the suture; on the front side with moderately long, but not abundant, black hair; on the posterior with longer black hair and thin black bristles. Scutellum with hair on its dorsum and a row of thin black bristles on its border; trichostical bristles hair-like, light colored. Abdomen shining bluish black, the narrow posterior border of the segments gray pollinose; on the sides of the segments with long white pile, and, in front of the posterior gray margin, with white bristles; hypopygium with short black pile; ovipositor rather long. Legs rather slender; black, with black bristles; all the tibiae and metatarsi, except the tip, yellow. Wings hyaline, the outer end only lightly clouded.

Length, 13-16 mm.

Numerous specimens, New Hampshire, Connecticut.

Asilus (Neoitamus) affinis, n. sp.

A single specimen from Washington agrees in most respects closely with *distinctus*, and I would be tempted to call it the same, were it

not for the very striking difference in the coloration of the legs. The front legs are wholly pure light yellow with the same colored hair and bristles, except a small black spot on the base of the femora above; the middle legs are of the same color, but the black stripe on the upper part of the femora extends two-thirds of the way to the tip, at the extreme tip there is also a very narrow blackish ring; some of the bristles are black and the short bristly hairs on the under side of the tarsi are black; the hind legs have the femora wholly black, the tip of the tibiae and the last joint of the tarsi also black; except the long pile on the inner and under side of the femora and the short pile on the inner side of the tibiae and metatarsi, the vestiture is wholly black. The convexity of the face also reaches a little further up and is covered wholly with yellow and abundant hair.

Length, 15 mm.

A female from California, may belong here. The yellow hair of the gibbosity has some black intermixed with it at the top and the femora are wholly black. The hair on the thorax is longer and more abundant in the middle in front.

Asilus (Tolmerus) notatus.

Asilus notatus Wiedemann, Auss. Zweifl. Insekten, i, 451.

Male, female. Face light grayish yellowish pollinose, the gibbosity clothed on the upper part with black bristles, on the lower part with thin, light yellow bristles; in profile the gibbosity is strong, and occupies a little more than half of the length of the face. Antennae black, the first two joints with black hair, the third about equal to the first two together, the bristle about as long as the joint. Front narrowed above, clothed with black hair. Occipito-orbital bristles black; beard silky white. Dorsum of thorax light yellowish gray pollinose, opaque; the median stripes, separated by a distinct interval, and the usual lateral spots, dark brown; in front with short black hair, behind with strong black bristles; scutellum usually with four bristles, two of them, especially the inner ones, sometimes small or obsolete; pleurae gray pollinose, the sparse vestiture wholly light-colored. Abdomen black, brown pollinose; when seen from behind more shining, except broadly on the sides, especially behind, and on the posterior margin of each segment, where it is light gray, or yellowish gray, pollinose, near the hind margin of each segment on the sides with two or three bristles. Legs black, with close, light colored hair and black bristles; base of all the tibiae, and the metatarsi except their tip, yellowish red; the front tibiae with several conspicuous bristles on the outer side, the inner side of the front tibiae and metatarsi with short, dense, orange red pile; hind femora noticeably less

thickened than the others. Wings hyaline, the outer end and the posterior cells lightly infuscated; both branches of the third vein sinuous, the first posterior cell not wider at the distal end than is the second submarginal cell.

Length, 15-17 mm.

Numerous specimens, Georgia, North Carolina, Michigan, South Dakota, New England.

Asilus (Tolmerus) callidus, n. sp.

Male, female. Four specimens from Mt. Hood, and six from Washington show a very great resemblance to *A. notatus*, but with the following differences: the gibbosity of the face extends further up, the legs are distinctly stouter, and all the femora have a conspicuous preapical red ring; the tibiae and tarsi in some are wholly deep red, with the base of the former lighter colored; in others, the tarsi are pitchy black or black, and the tibiae on their inner side colored in the same way.

In one female from Washington, the gibbosity does not seem to extend as high, the pollen of the thorax and of the sides of the face is yellowish, and the legs are black, with a broad preapical ring on the femora, and the base of the femora and of the metatarsi yellow.

Asilus (Rhadiurgus) leucopogon, n. sp.

Male, female. Face and front broad, densely covered with nearly white pollen; hair and bristles of the head everywhere white; face, in profile, nearly vertical and straight, a slight concavity on the upper part, only; the hair reaches to above the middle. Antennae black, the first two joints together rather longer than the third; arista rather stout, shorter than the third joint; beard abundant, silky. Dorsum of thorax densely light yellowish or brownish pollinose, the narrow brown stripes not conspicuous; clothed in front with short black and white bristles; behind with light-colored, not stout bristles. Scutellum with numerous, erect, white bristles and hairs. Pleurae and pectus densely white pollinose, with white hair and bristles. Abdomen elongate, slender, light grayish pollinose; when seen from behind brownish before the smooth, gray hind borders; oviduct cylindrical, shining, with a circlet of small bristles at the extremity. Legs with abundant, recumbent, white hair, and with white bristles; black, the base and more or less of the inner sides of the femora, the inner part of the tibiae, and the base of the tarsal joints, more or less yellow. Wings nearly pure hyaline; anterior branch of the third vein nearly straight, the posterior branch somewhat curved forward, but not reaching the tip of the wing.

Length, 15-17 mm.

Twenty-four specimens, South Dakota and Nebraska (J. M. Aldrich).

Asilus (Stenoprosopus) arizonensis, n. sp.

Female. Face and front rather narrow, wholly densely light yellow pollinose, the bristles of the face (which are mostly confined to the oral border) all white; face in profile vertical, without gibbosity, straight, or gently concave in the middle. Antennae black, the second joint yellowish; the first two joints with short black hair, together about as long as the third; second joint a little shorter than the first; arista about as long as the third joint. Beard not long, pure white. Thorax in ground-color largely reddish yellow; mesonotum opaque yellowish, with three broad, brown stripes, nearly bare in front, behind with stout bristles. Scutellum with a distinct groove before its apex, its border with two approximated bristles. Abdomen in ground-color black, with yellow hind borders; in life, apparently grayish-yellowish pollinose, with more distinctly yellow hind borders. Legs yellow; a spot on the upper side of the hind and front femora, the tip of all the tibiae, and the tip of the tarsal joints brownish; femora slender. Wings grayish hyaline, pure hyaline on the basal middle portion. Tip of the oviduct with small bristles.

Length, 17-18 mm.

One specimen, Arizona, (J. H. Comstock) No. 175.

Empis sociabilis, n. sp.

Male. Eyes closely contiguous. Frontal triangle and face bare, gray pollinose. Antennae black. Palpi slender; proboscis longer than the vertical diameter of the head. Thorax brownish gray, opaque, the mesonotum with three, narrow, inconspicuous, brown stripes. Abdomen brownish black, subshining; pile on the sides in front light-colored, rather long. Hypopygium small, black; the inferior lamellae small, ovate. Legs black. Wings hyaline; stigma narrow, brown.

Length, 5-6 mm.

Six specimens, Washington (Prof. C. V. Piper).

Chilosia chalybescens, n. sp.

Male. Eyes densely and long pilose; pile of dorsum of thorax yellow in front and behind, black across the middle; abdomen steel-blue. Frontal triangle with light-colored, vertical triangle with black, pile. Antennae black, the third joint rounded. Front and face shining black; face in profile with a long shallow concavity; lateral grooves well marked. Dorsum of thorax shining greenish black,

across the middle bluish black; pile in front and behind and on the scutellum light yellow; across the middle of the dorsum black; pile of pleurae black. Abdomen shining steel-blue, with light purplish reflections; first and second segments broadly opaque in the middle; pile abundant and moderately long, on the first and second segments light yellow, on the remainder of the abdomen black. Legs black; the hind tibiae and the tarsi in large part reddish. Wings somewhat brownish in front.

Length, 12 mm.

One specimen, California. This species is nearest allied to *C. occidentalis* Will.

Hystrichodexia Roederi, n. sp.

Male. Head pale golden yellow; thorax yellowish dusted; abdomen black, with the third, fourth and fifth segments opaque golden yellow. Front much narrowed behind, at the vertex scarcely one-fifth of the width of the head; frontal stripe reddish; sides of the front, the face and the cheeks light golden yellow. Antennae reddish yellow; second joint a little prominent; third joint four or five times the length of the second, slender; aris'a brown, thickened at the base. Proboscis black, longer than the head, slender, labella very small; palpi slender, slightly thickened near the end, yellow, with small black bristles. Dorsum of thorax, when seen from behind, opaque golden yellow, with four slender stripes, the lateral ones composed of two elongated spots; when seen from in front the golden color is not conspicuous. Scutellum more shining, the tip a little yellowish. Tegulae blackish. First and second segments of the abdomen deep reddish black, shining, clothed with short, recumbent bristles; second segment posteriorly with six approximated, stout, erect macrochaetae; the hind margin of the second segment, the third segment, save a lateral marginal spot, and the remaining segments almost wholly, opaque light golden yellow; third segment with a posterior girdle of macrochaetae, the fourth with a similar girdle beyond the middle; the third segment in front has recumbent black bristles; from the bristles of this segment nearly to those of the fourth the surface is entirely smooth. Venter piceous black, the second segment, at least, with a silvery white pollinose spot on each side. Legs black; front femora with a comb-like row of long bristles above and below; hind tibiae short, ciliate without; pulvilli and claws small, the former yellow. Wings brown on the basal costal portion, nearly hyaline elsewhere; antepenultimate section of the fourth vein longer than the penultimate section; ultimate section gently sinuous.

Length, 14 mm.

One specimen, Arizona. Although the abdomen of this species shows a much fewer number of the stout macrochaetae than in the other species of the genus, there can be no question of its congenerousness.

Kansas Pterodactyls.

BY S. W. WILLISTON.

PART II.

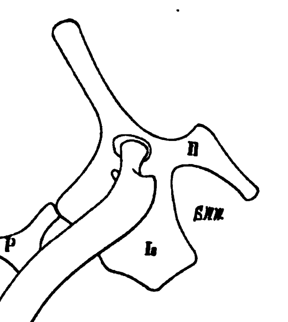
In my previous article on the Kansas Pterodactyls, in this QUARTERLY, vol. i, p. 12, I expressed the opinion that the genus *Pteranodon* occurs in Europe, founding it on the great similarity of certain bones figured by the early writers on these subjects. At the time, I was unaware of a recent publication* by Professor Seeley of London, wherein he held the same opinion. Since then Professor Seeley has kindly sent me copies of his papers, from the attentive examination of which I am satisfied that there can no longer be any reasonable doubt of the congenerousness of our species with those included in the genus *Ornithostoma* Seeley, a generic name antedating *Pteranodon* Marsh by some five years. The recent figures and descriptions given by Professor Seeley apply throughout to our forms, and, although not a great deal is yet known of the European species, the knowledge that we do possess is sufficient to dissipate all, or nearly all, the distinctive characters hitherto ascribed to the genus *Pteranodon.*

It is worthy of remark, as noticed by Seeley, that the first inkling of this identity was shown by Cope, whose acumen lead him to refer his fragmentary material to the genus *Ornithocheirus;* an acumen all the more noteworthy in contrast with the total incomprehension of their affinities displayed by Marsh, notwithstanding his wealth of material upon which to base an opinion.

A fuller description of the anatomical characters of the group I hope to publish in an early number of this journal, accompanied with a restoration of the skeleton; meanwhile the Kansas species hitherto placed in the genus *Pteranodon* may be known under the earlier generic name of *Ornithostoma,* and the family as the *Ornithostomatidae..*

In the present paper, I give a restoration of the pelvis and leg of the largest species, together with an amended description. It will be well to state that the restoration is made from three specimens, the leg from a specimen of *O. ingens,* the pelvis from two specimens of smaller size, appertaining to a closely allied, possibly identical species. The specimens from which the pelvis is drawn, have most of the bones

*Ann. Mag. Nat. Hist. 1891, p. 438.



of the leg, so that it was an easy matter to amplify the pelvis to a size corresponding with that of the remaining bones.

The ilium has a long anterior projection, moderately expanded distally. Posteriorly, it extends more stoutly upward and backward from the acetabulum, to form a close union with three vertebrae, terminating in a stout, styliform tuberosity on either side of the base of the tail. If, as Seeley thinks, the pubis and ischium are conjoined, they are thoroughly co-ossified throughout, forming a broad, antero-posterior plate, which is narrowed to a symphysis about one inch in length in medium-sized species. Projecting downward and forward, about midway between the acetabulum and symphysis, there is a moderately thickened, angular projection, evidently tipped with cartilage in life. It is evident that the pubis (or prepubis?) was attached to this process, and I have so restored the pelvis. A little below the acetabulum, and just before the middle of the conjoined plate, is the oval, antero-posterior pubic foramen. On the border of the ischium behind, a little above the symphysis, there is a second tuberosity, larger and stouter than the pubic one. Between this tuberosity and the iliac tuberosity, directly above, there is a large, deep, sciatic notch. These thickened projections seem to indicate that the animal in life was in the habit of resting upon these parts, a supposition further helped by the weakness of the legs, and by the structure of the femur. The co-ossified pubic bones are very thin, probably U-shaped in life, with an anterior projection for the attachment of a ventral rib, and with a slightly expanded symphysis. A figure of them is given in my previous paper (this journal, I, p. 4,). I confess myself undecided as to whether the bone really represents the pubis or the prepubis.

The femur is a moderately stout bone, considerably shorter than the tibia, considerably curved, with a slender neck, set at only a slight angle with the shaft,

a nearly spherical head, and small trochanter—all of which, together with the rather shallow, imperforate acetabulum, would indicate great freedom of movement in the legs and a corresponding lack of strength. The tibia is a slender bone, without marked cnemial crest, and with a well-developed trochlear surface below. I know of no indication of a separate fibula.

There are three tarsal bones, two of which are cuboid or angular in shape. The third is larger, and has a downwardly directed, pointed, curved process; it seems to be a rudimentary fifth digit. The foot is elongate and slender, the metatarsals articulating closely together above, with the claws much smaller and less curved than those of the manus, save, perhaps, in the inner digits, where they seem to be wanting, the preceding phalanx being obtusely pointed. There are four functional toes, with probably a rudiment of the fifth, as already stated. The relative lengths of the elongated metatarsals may be indicated by the figures 2, 1, 3, 4, the second being the longest. The phalanges may be represented by the formula I-1, II-2, III-4, IV-5, thus, as in the European species, corroborating the evidence that the fifth toe is the one that is missing. All the phalanges are slender, save the second one in the third toe, and the second and third in the fourth toe, where they are scarcely longer than wide.

EXPLANATION OF FIGURE.

Pelvis and leg of *Ornithostoma ingens*, one fifth natural size. *Il*, ilium; *Is*, ischium; *P*, prepubis; *F*, femur; *Tb*, tibia; *T*, tarsus; *I*, *V*, first, fifth digits.

Kansas Mosasaurs.

BY S. W. WILLISTON.

PART II*.

RESTORATION OF CLIDASTES, WITH PLATE III.

In this QUARTERLY, vol. I, page 15, was given a description, by Mr. E. C. Case and the writer, of an unusually complete specimen of a Mosasaur from western Kansas, referred to *Clidastes velox* Marsh. During the past year careful drawings have been made, not only in this genus, but also in the other genera of the Kansas Mosasaurs, of the skull and other parts of the skeleton. In the accompanying plate, pen and ink copies of two of these have been reproduced, together with a restoration of the skeleton of Clidastes velox.

The first known specimen of this interesting group of reptiles was exhumed by Hofmann, an army surgeon, from an underground quarry near Maestricht, in 1789. The owner of the ground lying over the quarry, however, obtained possessions of the highly prized bones by process of law. At the siege of Maestricht by the French, in 1795, it is said that the cannoneers were instructed to avoid firing into that part of the town where the specimen was supposed to be. At the capitulation, the specimen had been hidden, but was recovered by a bribe of six hundred bottles of wine, and taken to Paris, where it was studied by Cuvier.

Since that time, numerous incomplete specimens of these animals have been discovered, in Europe, North America, and New Zealand, and many species and genera have been described, but no restoration, save a conjectural one by Cope, has been attempted. The present restoration is in nowise conjectural; it is based wholly upon the single specimen mentioned above, which includes all parts of the skeleton, with the exception of some of the finger and toe bones, whose absence is indicated by dotted lines in the drawing. In the arrangement of the ribs, a natural skeleton of *Iguana tuberculata* has been followed by the artist; otherwise the restoration has been made from the fossil bones. For a description of the osteology, the reader is referred, for the present, to the above-cited paper. The writer has begun the

*For part I, see this Quarterly, vol. I. p. 15, July, 1892.

preparation of a monograph of the Kansas species of these animals, in which a fuller description will properly find a place.

In the skull, the palatals and vomers have been so distorted in the chief specimen of *C. velox* as to prevent their shape being made out with certainty. These bones have, therefore, been added from a perfectly preserved skull of *C. tortor* Cope in the University Museum.

Linear Geometry of the Cubic and Quartic.

BY H. B. NEWSON.

PART I.

INVARIANTS OF THE SYSTEM OF A POINT AND A CUBIC.

Let there be given two binary forms, one of the third degree and the other of the first. Let the former be written $C=ax^3+3bx^2y+3cxy^2+dy^3=0$; and the latter, $P=a_1x+b_1y=0$. Interpreted according to the conventions of Linear Analytic Geometry, the equation $P=0$, represents a point on a fixed line; and $C=0$ represents a group of three points on the same line. Two fixed points, A and B, on the line are the Ground Points of the system of binary co-ordinates. I shall call the group of three points represented by the equation, $C=0$, a *cubic;* in like manner a group of two points given by a quadratic equation will be called simply a *quadratic;* etc.

These two groups of points $P=0$ and $C=0$, give us a group of four points on a line. I propose to investigate the Invariants of this system, P and C, by means of the anharmonic ratio of the four points.

Let $x+R_1y$, $x+R_2y$, $x+R_3y$ be the three factors of the cubic; where

$$R_1=\frac{b}{a}-\frac{p^{\frac{1}{3}}}{a}+\frac{H}{ap^{\frac{1}{3}}};\ R_2=\frac{b}{a}-\frac{wp^{\frac{1}{3}}}{a}+\frac{w^2H}{ap^{\frac{1}{3}}};\ R_3=\frac{b}{a}-\frac{w^2p^{\frac{1}{3}}}{a}+\frac{wH}{ap^{\frac{1}{3}}},$$

and $H=ac-b^2$; $G=a^2d-3abc+2b^3$; $p=\frac{1}{2}(-G+\sqrt{G^2+4H^3})$;

w is one of the imaginary cube roots of unity, viz: $\left[\frac{-1+\sqrt{-3}}{2}\right]$.

The anharmonic ratio k of the four points given by $x+R_1y=0$, $x+R_2y=0$, $x+R_3y=0$ and $x+\frac{b_1}{a_1}y=0$ is

$$k=\frac{R_3-R_1}{R_2-R_3}:\frac{R_4-R_1}{R_2-R_4}=$$

$$\frac{\frac{p^{\frac{1}{3}}}{a}-\frac{H}{ap^{\frac{1}{3}}}-\frac{w^2p^{\frac{1}{3}}}{a}+\frac{wH}{ap^{\frac{1}{3}}}}{\frac{w^2p^{\frac{1}{3}}}{a}-\frac{wH}{ap^{\frac{1}{3}}}-\frac{wp^{\frac{1}{3}}}{a}+\frac{w^2H}{ap^{\frac{1}{3}}}}:\frac{\frac{b_1}{a_1}-\frac{b}{a}+\frac{p^{\frac{1}{3}}}{a}-\frac{H}{ap^{\frac{1}{3}}}}{\frac{b}{a}-\frac{b_1}{a_1}-\frac{wp^{\frac{1}{3}}}{a}+\frac{w^2H}{ap^{\frac{1}{3}}}}.$$

This readily reduces to

$$k = -w\frac{(p^{\frac{2}{3}} + wH)(Dp^{\frac{1}{3}} + a_1 w p^{\frac{2}{3}} - a_1 w^2 H)}{(p^{\frac{2}{3}} + H)(Dp^{\frac{1}{3}} + a_1 p^{\frac{2}{3}} - a_1 H)};$$

$$\text{where } D = \begin{vmatrix} a & b \\ a_1 & b_1 \end{vmatrix}.$$

I shall now give a geometric definition of an invariant of a binary form. An invariant of one or more binary forms is any function of the coefficients whose vanishing expresses the condition that the points forming the group or groups have to one another some relation unaltered by any projection whatever.

The anharmonic ratio of four points is absolutely unaltered by any projection whatever, and hence the above expression for k is an absolute invariant of the system P and C. Moreover, by giving different values to k, we may obtain an infinite number of absolute invariants of the system. Among this infinite number of invariants are a limited number of primary or fundamental invariants out of which all the others may be compounded. We may obtain from the above expression for k all these fundamental invariants by giving to k its Critical Values.

I must explain what I mean by critical values of k. The six expressions for the anharmonic ratios of four points on a line are k, $\frac{1}{k}$, $1-k$, $\frac{1}{1-k}$, $\frac{k-1}{k}$, and $\frac{k}{k-1}$. A critical value of k is any number which substituted for k will cause two or more of the six expressions to have equal values. Thus, 1, 0, and ∞ are critical values of k; and the geometric meaning is, that two of the four points coincide. Also $\frac{1}{2}$, -1, and 2 are critical values of k; and the four points then form a harmonic range. Lastly, $-w$ and $-w^2$ are critical values of k, the four points then forming an equi-anharmonic range. We have thus eight critical values of k, and there are no more.

These eight critical values of k substituted in the above equation will not always give fundamental invariants; but all fundamental invariants of the system will be included among those found by giving these eight critical values to k; any compound ones thus obtained will be easily recognized.

We now proceed to give to k in the above equation the critical values 1, 0, and ∞. Substituting and reducing we obtain the following results:

For $k = \infty$, we have $p^{\frac{2}{3}} + H = 0$; or $Dp^{\frac{1}{3}} + a_1 (p^{\frac{2}{3}} - H) = 0$;

For $k=0$, we have $p^{\frac{2}{3}}+wH=0$; or $Dp^{\frac{1}{3}}+a_1(wp^{\frac{2}{3}}-w^2H)=0$;

For $k=1$, we have $p^{\frac{2}{3}}+w^2H=0$; or $Dp^{\frac{1}{3}}+a_1(w^2p-wH)=0$.

It will be observed that the first factors in each of the expressions above are factors of the expression $p^2+H^3=0$; and the last factors are factors of the expression $D^3p+3D^2pa_1^2H+a_1^3pG=0$.

It can readily be verified that $p^2+H^3=-p\frac{1}{4}(G^2+4H^3)$. Since $\frac{1}{4}((G^2+4H^3)=a^2\triangle$, where D^1 is the discriminant of the cubic; we have $a^2p^2\triangle=(p^2+H^3)^2$. Hence $p^2+H^3=0$ is equivalent to $\triangle=0$. $\triangle$ is a fundamental invariant of the cubic only.

It can also be readily verified that

$$p(D^3+3D^2a_1^2H+a_1^3G)=-a^2pE,$$

where $E=ab_1^3-3ba_1b_1^2+3ca_1^2b_1-da_1^3$, the eliminant of P and C.

Thus, by giving to k the critical values 1, 0, ∞, we obtain two fundamental invariants whose vanishing expresses in the one case the condition that the point P coincides with one of the points of C; and in the other, that two points of C coincide.

If in equation (1) we give to k the values $-w$ and $-w^2$, we obtain after reduction the following values:

When $k=-w$, we have $p^{\frac{1}{3}}(DH+ap)=0$,

when $k=-w^2$, we have $pD-a_1H^2=0$.

These expressions equated to zero yield, after squaring, the same result. Their product is free from radicals and gives us

$p^{\frac{4}{3}}(D^2H-a_1DG-a_1^2H^2)$. It can readily be verified that

$$D^2H-a_1DG-a_1^2H^2=a^2E_1,$$

where $E_1=(ac-b^2)b_1^2+(bc-ad)a_1b_1+(ad-c^2)a_1^2$.

We recognize this at once as the eliminant of P and the Hessian of C. This is another fundamental invariant of the system of point and cubic.

Again let us give to k in succession the values $\frac{1}{2}$, 2, and -1. We have after reduction the following results:

When $k=\frac{1}{2}$ then $(Dp-a_1H^2)-p^{\frac{1}{3}}(ap+DH)=0$;

when $k=2$ then $(Dp-a_1H^2)-wp^{\frac{1}{3}}(a_1p+DH)=0$;

when $k=-1$ then $(Dp-a_1H^2)-w^2p^{\frac{1}{3}}(a_1p+DH)=0$.

Each of these expressions after expanding and cubing leads to the same result. Hence we may more simply use their product which is

$$(Dp-a_1H^2)^3-p(a_1p+DH)^3=0.$$

Expanding this and observing that $p^2-H^3=-\dot{G}p$, and

$$p^4+H^6=p_2(G^2+2H^3) \text{ we have}$$

$$P^2(D^3G-3a_1DHG+6a_1D^2H^2+a_1^3H^2)=0.$$

It may now be easily verified that the last quantity in parenthesis is equivalent to a^3E_2; where E_2 is the eliminant of P and the Cubi-covariant of C. This gives us another fundamental invariant of the system P and C, and completes the list. We have four fundamental invariants of the system, viz: $\triangle$, E, E_1 and E_2. These four quantities are connected by the relation $\triangle E^2=E_2^2+4E_1^3$.

INVARIANTS AND COVARIANTS OF A CUBIC.

It is an easy matter by a very simple device to obtain by the above method a complete list of the invariants and covariants of a cubic. But we must first give a geometric definition of a covariant of a binary form. A covariant of one or more groups of points on a line is a group of points which bears to the given group or groups some relation unaltered by any projection whatever.

Now instead of representing the point P by the linear equation $a_1x+b_1y=0$, we may say that (x, y) are the coördinates of a movable point on the line. Solving the equation $a_1x+b_1y=0$, we have the ratio $\frac{x}{y}=-\frac{b_1}{a_1}$. If we substitute in the formula given above for k, $\frac{x}{y}$ in place $-\frac{b_1}{a_1}$, the expression for k gives us a homogeneous equation in x and y. And since the value of k is unaltered by any projection whatever, we have, by giving different values to k, the equations of an infinite number of covariants of the cubic. The fundamental covariants are found as before by giving to k its critical values. But instead of repeating the above operations we may readily find the fundamental invariants and covariants of the cubic by substituting $\frac{x}{y}$ for $-\frac{b_1}{a_1}$ in $\triangle$, E, E_1, and E_2. The results are $\triangle$, the discriminant; C, the cubic itself; H_x, the Hessian; and G_x, the cubi-covariant. It is necessary, however, in order to bring to light some of the fundamental properties of these covariants to go back to the formula for k. Making the proposed substitution of $\frac{x}{y}$ for $-\frac{b_1}{a_1}$ in the expression for k we get

$$k=-w\frac{(p^{\frac{2}{3}}+wH)\{(ax+by)p^{\frac{1}{3}}-y(wp^{\frac{2}{3}}-w^2H)\}}{(p^{\frac{2}{3}}+H)\{(ax+by)p^{\frac{1}{3}}-y(p^{\frac{2}{3}}-H)\}}.$$

This readily reduces to the form

$$(ax+by)\{(k+w)p+(k+w^2)p^{\frac{1}{3}}H\}-y\{(k+w^2)p^{\frac{4}{3}}-(k+w)H^2\}=o.$$

This is a linear equation and represents some point on the line. By giving to k different values this equation may be made to represent all points on the line. By giving to k in succession the values 1, o, and ∞, we obtain the three linear factors of the cubic, each multiplied by a constant. The product of these three factors L_1, L_2, and L_3, is $L_1L_2L_3=a^3p^2\triangle^{\frac{1}{2}}C$.

By giving to k in succession the values $-w$ and $-w^2$, we get for the linear factors of the Hessian

$$p^{\frac{1}{3}}\{(ax+by)H-py\}=o, \text{ and } \{(ax+by)p+H^2y\}=o.$$

The product of these factors f_1 and f_2 is

$$p^{\frac{1}{3}}f_1f_2=p^{\frac{4}{3}}a^2H_x;\ \text{or}\ f_1f_2=pa^2H_x.$$

By giving to k the values $\frac{1}{2}$, 2, and -1, we have

$$f_2-p^{\frac{1}{3}}f_1=o;\ f_2-wp^{\frac{1}{3}}f_1=o;\ \text{and}\ f_2-w^2p^{\frac{1}{3}}f_1=o.$$

The product of these three factors is $pf_1^3-f_2^3=a^3p^2G_x$.

This last equation gives an expression for the cubi-covariant in terms of the factors of the Hessian.

The equation of relation among the invariants of P and C, viz: $\triangle E^2=E_2^2+4E_1^3$ becomes, when $\frac{x}{y}$ is substituted for $-\frac{b_1}{a_1}$,

$$\triangle C^2=G_x^2+4H_x^3.$$

COVARIANTS OF THE SYSTEM OF THE POINT AND CUBIC.

In the investigation of the covariants of the system of the point and cubic I shall make use of a principle which it is not necessary for me to stop to prove. It is this: the relation of pole and polar in geometry of one dimension as well as in geometry of two and three dimensions is unaltered by projection. The successive polars of the point P with respect to the cubic C and its covariants are unaltered by projection, and hence are covariants of the system. And moreover the complete set of such polars is identical with the complete list of fundamental covariants of the system.

Assuming these principles as sufficiently well known, it is easy to write down a complete list of the covariants of the system.

(1). *Two cubic covariants*, viz: the cubic itself, C; and the cubi-covariant G_x. These written in full are $C=ax^3+3bx^2y+3cxy^2+dy^3$.

$$G_x=(a^2d-3abc+2b^3)x^3+3(abd+b^2c-2ac^2)x^2y$$
$$+3(2b^2d-acd-bc^2)xy^2+(3bcd-ad^2-2c^3)y^3.$$

(2). *Three quadratic covariants*, viz: the first polar P with respect to C, Q_1; the first of P with respect to G_x, Q_2; and the Hessian of the cubic, H_x. These written in full are

$$Q_1=(ab_1-a_1b)x^2+2(bb_1-a_1c)xy+(b_1c-a_1d)y^2.$$
$$Q_2=(a^2b_1d-3abb_1c+2b^3b_1-aa_1bd-a_1b^2c+2aa_1c^2)x^2$$
$$+2(abb_1d+b^2b_1c-2ab_1c^2+aa_1cd+a_1bc^2-2a_1b^2d)xy$$
$$+(2b^2b_1d-ab_1cd-bb_1c^2-3a_1bcd+aa_1d^2-2a_1c^3)y^2.$$
$$H_x=(ac-b^2)x^2+(ad-bc)xy+(bd-c^2)y^2.$$

(3). *Four linear covariants*, viz: the point P; the second polar of P with respect to C (which is identical with the polar of P with respect to Q_1), P_1; the second polar of P with respect to G_x (which is identical with the polar of P with respect to Q_2), P_2; and the polar of P with respect to H_x. These written in full are

$$P=a_1x+b_1y;\ P_1=(ab_1^2-2a_1b_1b+a_1^2c)x+(b_1^2b-2a_1b_1c+a_1^2d)y.$$
$$P_2=(a^2b_1^2d-3abb_1^2c+2b^3b_1^2-2aa_1bb_1d-2a_1b^2b_1c+4aa_1b_1c^2$$
$$+2a_1^2b^2d-a_1^2bc^2-aa_1^2cd)x+(abb_1^2d+b^2b_1^2c-2ab_1^2c^2-4a_1b^2b_1d$$
$$+2aa_1b_1cd+2a_1bb_1c^2+3a_1^2bcd-aa_1^2d^2-2a_1^2c^3)y.$$
$$P_3=(2ab_1c-2b_1b^2+aa_1d-aa_1c)x-(ab_1d-bb_1c+2a_1bd-2a_1c^2)y$$

In calculating the foregoing polars it is convenient to make use of the following theorem: the first polar of the point, $P=a_1x+b_1y$, with respect to any binary quantic U is identical with the Jacobian of P and U.

This theorem is easily proved as follows: the polar of any point (x, y) with respect to any quantic U is given by the operation

$\left[x_1\frac{d}{dx}+y_1\frac{d}{dy}\right]$ U; or $\left[\frac{x_1d}{y_1dx}+\frac{d}{dy}\right]$ U. But if the equation of the point (x_1, y_1) is $P=a_1x+b_1y=0$, then, $\frac{x_1}{y_1}=-\frac{b_1}{a_1}$.

Substituting this value of $\frac{x_1}{y_1}$ in the above operation for the polar, we have $\left[\frac{-b_1d}{dx}+a_1\frac{d}{dy}\right]U=0$. But $a_1=\frac{dP}{dx}$, and $b_1=\frac{dP}{dy}$; whence the last equation gives

$$\frac{dP}{dx}\frac{dU}{dy}-\frac{dP}{dy}\frac{dU}{dx}=\begin{vmatrix}\frac{dP}{dx} & \frac{dP}{dy}\\ \frac{dU}{dx} & \frac{dU}{dy}\end{vmatrix}=0;$$

which is the Jacobian of P and U. All the above polars of P with respect to the various quantics are readily calculated as Jacobians.

When the equation of the cubic is written in the full form

$ax^3+3bx^2y+3cxy^2+dy^3=0$, as above, the ground points of the system of binary coördinates are not in any special relation to the points of the cubic. But any two points on the line may be chosen for ground points. If by choosing for ground points two points on the line specially related to the points of the cubic, we can simplify the equations of the cubic and its covariants, we are at liberty to do so. The most convenient points to choose for ground points of our system of binary coördinates are the two points constituting the Hessian of the cubic. The equation of the Hessian in full is

$$(ab-c^2)x^2+(ad-bc)xy+(bd-c^2)y^2=0;$$

and the equation of the ground points is, of course, $xy=0$. We observe that if b and c are put equal to zero, the Hessian reduces to $adxy=0$; and hence becomes identical with the ground points. Choosing, therefore, the points of the Hessian for ground points, the equations of the cubic and its system of covariants are all reduced to their simplified or *canonical* forms by putting $b=0$ and $c=0$.

The canonical forms of the above quantics are as follows:

(1). $C=ax^3+dy^3$; $G_x=ad(ax^3-dy^3)$.

(2). $Q_1=ab_1x^2-a_1dy^2$; $Q_2=ad(ab_1x^2+a_1dy^2)$; $H=adxy$.

(3). $P=a_1x+b_1y$; $P_1=ab_1^2x+a_1^2dy$; $P_2=ad(ab_1^2x-a_1^2dy$;)

$$P_3=ad(a_1x-b_1y).$$

The invariants of the system $\triangle$, E, E_1, E_2, reduce to

(4). $\triangle=a^2d^2$; $E=ab_1^3-da_1^3$; $E_1=ada_1b_1$; $E_2=ad(ab_1^3-da_1^3)$.

We shall hereafter make use of these canonical forms in studying the geometric and other properties of the cubic.

INVARIANTS OF THE QUARTIC.

The invariants of a quartic may be determined by means of the anharmonic ratio of the four points constituting the quartic, in a manner entirely similar to that which we used for determining the invariants of the system of point and cubic. Let the general equation of the quartic be written in the form

$$ax^4+4bx^3y+6cx^2y^2+4dxy^3+ey^4=0.$$

Let the four factors of the quartic be represented by

$$x+R_1y;\ x+R_2y;\ x+R_3y;\ \text{and } x+R_4y.$$

where $R_1=\frac{b}{a}-\sqrt{p}+\sqrt{q}+\sqrt{r}$, $R_2=\frac{b}{a}+\sqrt{p}-\sqrt{q}+\sqrt{r}$,

$$R_3=\frac{b}{a}+\sqrt{p}+\sqrt{q}-\sqrt{r},\ R_4=\frac{b}{a}-\sqrt{p}-\sqrt{q}-\sqrt{r}.$$

In these expressions $p=a^2z_1-H$, $q=a^2z_2-H$, $r=a^2z_3-H$; where $H=\begin{vmatrix} a & b \\ a & b \end{vmatrix}$ and z_1, z_2, z_3 are the three roots of the reducing cubic of the

quartic, viz: $4a^3z - aIz + J = 0$. In this equation $I = ae - 4bd + 3c^2$, and $J = ace + 2bcd - ad^2 - eb^2 - c^3$.

The anharmonic ratio of the four points represented by $x + R_1y = 0$, $x + R_2y = 0$, $x + R_3y = 0$, and $x + R_4y = 0$ is given by

$$k = \frac{R_3 - R_1}{R_2 - R_3} : \frac{R_4 - R_1}{R_2 - R_4} = \frac{(\sqrt{p} - \sqrt{r})(\sqrt{p} + \sqrt{r})}{(\sqrt{r} - \sqrt{q})(-\sqrt{q} - \sqrt{r})} = \frac{p - r}{q - r} = \frac{z_1 - z_3}{z_2 - z_3}.$$

By solving the reducing cubic we find the following values of z_1, z_2, and z_3;

$$z_1 = u^{\frac{1}{3}} - \frac{v}{u^{\frac{1}{3}}},\quad z_2 = wu^{\frac{1}{3}} - w^2\frac{v}{u^{\frac{1}{3}}},\quad z_3 = w^2u^{\frac{1}{3}} - w\frac{v}{u^{\frac{1}{3}}}.$$

$$\text{Where } v = -\frac{I}{12a^2}, \text{ and } u = -\frac{1}{8a^2}\left\{-J + \sqrt{\frac{27J^2 - I^3}{27}}\right\}.$$

Substituting these values of z_1, z_2, and z_3 in the above expressions for k we get

$$k = -\frac{wu^{\frac{2}{3}} + w^2v}{u^{\frac{2}{3}} + v}.$$

The fundamental invariants of the quartic are now obtained from the above equation by giving to k its critical values. Let us give to k the values -1, 2, $\frac{1}{2}$.

$$\text{When } k = -1, \text{ we have } u^{\frac{2}{3}} - w^2v = 0;$$

$$\text{when } k = 2, \text{ we have } u^{\frac{2}{3}} - wv = 0;$$

$$\text{when } k = \frac{1}{2}, \text{ we have } u^{\frac{2}{3}} - v = 0.$$

Each of these expressions when transposed and cleared of radicals leads to the same result. The product of the expressions is $u^2 - v^3 = 0$, which is free from radicals and imaginaries. Substituting the above values of u and v in this equation, the expression reduces to $J = 0$.

$J = ace + 2bcd - ad^2 - eb^2 - c^3$ is, therefore, a fundamental invariant of the quartic; and is also the condition that the four points constituting the quartic should form a harmonic range.

Giving to k its critical values $-w$ and $-w^2$, we get the following results:

$$\text{when } k = -w, \text{ we have } v = 0;$$
$$\text{when } k = -w^2, \text{ we have } v = 0.$$

But since $v = -\frac{I}{12a^2}$, we have $I = ae - 4bd + 3c^2$ as another fundamental invariant of the quartic. It is also the condition that the four points constituting the quartic should form an equi-anharmonic range.

Again let us give to k the values 1, 0, ∞:

$$\text{when } k=1, \text{ we have } u^{\frac{2}{3}}+w^2v=0;$$

$$\text{when } k=0, \text{ we have } u^{\frac{2}{3}}+wv=0;$$

$$\text{when } k=\infty, \text{ we have } u^{\frac{2}{3}}+v=0.$$

These expressions are factors of $u^2+v^3=0$. Substituting the values of u and v, this expression reduces to $I^3-27J^2=0$.

This expression, I^3-27J^2, is an invariant of the quartic, and its vanishing is the condition that two of the four points constituting the quartic should coincide. But it is not a fundamental invariant of the quartic, since it is composed of I and J. We conclude, therefore, that the quartic has only two fundamental invariants, I and J.

On the Delicacy of the Sense of Taste Among Indians.

BY E. H. S. BAILEY.

(Read before the American Association of Science, at the Madison, Wis., meeting, 1893.)

At the Philadelphia meeting of this association, the author, in connection with E. L. Nichols, presented the results of some experiments on the "Delicacy of the Special Senses," and more recently articles on this and related topics have been published in several periodicals.* In all these series of tests the same general method, as outlined below, has been followed. The object in each set of tests has been to arrive at the *average* delicacy. On account of the wide variation in the results of the experiments with different individuals, it is possible to generalize only after a large number of tests have been made. In any series of this kind, then, the results may be said to point in a certain direction, rather than to warrant a definite statement.

A special opportunity for testing the Indian race was afforded on account of the fact that at Haskell Institute, in Lawrence, Kansas, there are congregated four or five hundred Indians, collected from the northern and western part of the United States by the government for educational purposes. They come, at the present time, from no less than thirty-six different tribes, and represent all degrees of civilization. They are by no means all pure-blooded, for German, Irish, French, English and Negro blood can be detected in their features and the nationality can be recognized in their names. The pupils are of various ages—from five to twenty-five—but the tests described below were made with boys and girls from twelve to about twenty-one years of age.

The method of testing the delicacy of the sense of taste may be briefly outlined as follows: Solutions of known strength, of the substance to be tasted, were made. These solutions were then successively diluted, each one being made of one-half the strength of the preceding one in its class, till the solution was so dilute that it was not

*On the relative bitterness of different bitter substances, Kas. Acad. of Science, vol. X.
On the relation between the taste and the acidity of certain acids, Kas. Acad. Science, vol. XI.
On the delicacy of the sense of taste, Science, vol. XI; also Nature, March, 1888.
Note also article by E. E. Slosson on the sweetness of certain alcohols, Kas. Acad. of Science, vol. XII.

possible to recognize the substance that it contained. Then the bottles containing these substances, and a few bottles containing water of the same kind as that used in making the solutions, were placed, without regard to order, and the experimenter was requested to classify the different substances and to place in special groups all that he could distinguish, while those that he did not recognize he was to place in the group called water.

The substances quinin sulfate (bitter), sulfuric acid (sour), sodium bicarbonate (alkaline), cane sugar (sweet) and common salt (salt) have been selected as representing classes of the common familiar substances most likely to be recognized. The only one of these that experience has shown is not familiar is the alkaline taste. It is, of course, necessary in selecting a substance for this test that it should have no odor, as that would enable the experimenter to detect it by the closely allied sense of smell. It must also be devoid of color when dissolved in water.

It has been found, in these preliminary experiments with the Indians, that there is much more to contend with than with the whites. This arises from the fact that the former are not well acquainted with the language that we use in describing the different tastes, and often they evidently cannot name a taste that is perfectly apparent to them. They are honest and interested in the tests and seem anxious to make as good a record as possible. In order to avoid the difficulties mentioned as much as possible, cards were printed and given to the experimenters and they were told to place them with each group as selected. Thus, "These taste like quinin or bitter;" "These taste sour like alum or vinegar," and so on. In addition to this, strong solutions of each substance to be tested were passed around so that each might familiarize himself with the taste and its proper name before making the test.

On account of the slowness with which the work must be carried on it has been possible only to make a few tests thus far. There were thirty-one boys and thirty-six girls who made the tests. The results obtained are expressed in parts of the substance detected, and the average is taken in each case. Thus, "one part in 77,400," means that the observer could detect one gram, for instance, if dissolved in 77,400 grams of water.

SUBSTANCES.	DETECTED BY MALES.	DETECTED BY FEMALES.	AVERAGE.
Bitter	1 part in 77,400	1 part in 136,600	107,000
Sweet	1 part in 102	1 part in 137	120
Acid	1 part in 1,920	1 part in 2,200	2,060
Alkali	1 part in 106	1 part in 100	103
Salt	1 part in 320	1 part in 281	300

It may be of interest to compare these results with those obtained when experimenting with a class of white pupils some time ago. They were of nearly the same age as the Indians. The number selected for the comparison is twenty-six males and twenty-six females.

SUBSTANCES.	DETECTED BY MALES.	DETECTED BY FEMALES.	AVERAGE.
Bitter	1 part in 600,000	1 part in 755,000	678,000
Sweet	1 part in 128	1 part in 128	128
Acid	1 part in 3,520	1 part in 4,160	3,840
Alkali	1 part in 160	1 part in 192	176
Salt	1 part in 480	1 part in 320	400

From an examination and comparison of these results it may be noticed that the order of delicacy is about the same for the two races. By that is meant that both races can detect the smallest part of quinine, the next smallest part of an acid and so on. In the experiments note above upon the bitter substances, when only bitter substances were tasted it was found that the average amount of quinin that could be detected was one part in 76,000. Here, where a variety of substances is presented to the organs of taste the whites can detect a much smaller amount.

It is also evident that the ability to detect the different substances when they are in very dilute solutions is less in the Indians than in the whites. This may be ascribed to various causes, but after all the most important is no doubt lack of familiarity with the different substances. There have been no opportunities to cultivate the sense of taste as highly as it is cultivated in the white race. It has so frequently been demonstrated that this sense in common with others can be cultivated, that we rather expect to find lack of delicacy among the Indians.

The males seem to be able to detect a smaller quantity of salt than the females. As this is the result of observation with both races, it may not be accidental, but may be due to the habits of the different sexes.

In other cases the females appear to have the more delicate organ of taste. As this has been the experience in a number of individual sets of tests, it is probably not accidental. Some have attempted to explain this by the fact that men more frequently use tobacco, others by the facility that women have for tasting substances used in cooking and in the preparation of food. The Indians at the schools are not supposed to use tobacco, but as they often do, it is not best to assume too much as to their habits. In the class of whites tested were many who were students in chemistry and pharmacy and who are supposed to cultivate the sense of taste especially.

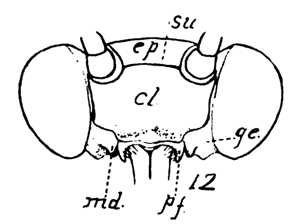
Some of the Indians tested were able to compete with the average of the whites in tasting small amounts of substances, while some seemed to know very little what taste meant. Some could with difficulty detect the difference between a strong bitter and a strong acid substance. As was anticipated there was difficulty in distinguishing between the alkali and the salt solutions, and this largely accounts for the relatively small figure representing the amount of salt that can be detected. In making the tests the solutions were poured from a bottle into a spoon and the experimenter was allowed to swallow the liquid if he chose. Very few did this however, but seemed to trust moree specially to the nerves about the tip of the tongue. If several spoonsful of each liquid had been swallowed it might have added to the delicacy of the tests.

PLATE II.

Fig. 1. Hind aspect, head of *Protoparce carolina* Linn.
Fig. 2. Front aspect, head of *Protoparce carolina* Linn.
Fig. 3. Hind aspect, head of *Pamphila leonardus* Harr.
Fig. 4. Front aspect, middle head of an exotic Hesperid butterfly.
Fig. 5. Front aspect, head of *Argynnis cybele* Fabr.
Fig. 6. Hind aspect, head of *Actias luna* Linn.
Fig. 7. Under aspect, middle head of *Triptogon modesta* Harr.
Fig. 8. Under aspect, head of *Danais archippus* Fabr.
Fig. 9. Hind aspect, head of *Danais archippus* Fabr.
Fig. 11. Front aspect, head of *Danais archippus* Fabr.
Fig. 12. Front aspect, head of *Hemaris thysbe* Fabr.
Fig. 13. Under aspect, middle head of *Catocala* sp.
Fig. 14. Front aspect, slightly turned, head of *Catocala* sp.

ABBREVIATIONS.

ep, epicranium.
p g, post-gena.
o f, occipital foramen.
su'', suture between epicranium and gena.
ge, gena.
md, mandible.
su, suture between epicranium and clypeus.
mx, maxilla.
l p, labial palpus (basal segment).
tent, tentorium.
mx p, maxillary palpus.
epx, epipharynx.
oc, occiput.
eye, compound eye.
su', suture between gena and post-gena.
su''', suture between epicranium and post-gena.
cl, clypeus.
lb, labrum.
pf, pilifer.
lm, labium.
gu, gula.
mx, maxillar proboscis.
mx b, fixed basal portion of maxilla.




Mary Wellman, ad nat. del.

PLATE III.

Fig. 1. Restoration of *Clidastes velox* Marsh, one-twelfth natural size.

Fig. 2. Skull of *Clidastes velox* from above, two-ninths natural size.

Fig. 3. Skull of *Clidastes velox* from below, two-ninths natural size.

EXPLANATION. — *prm*, premaxillary; *m*, maxillary; *f*, frontal; *prf*, prefrontal; *pfr*, postfrontal; *po*, postorbital; *p*, parietal; *q*, quadrate; *qj*, quadrato-jugal; *oc*, occipital condyle; *v*, vomer; *pal*, palatine; *pt*, pterygoid; *ept*, ectopterygoid process of pterygoid; *j*, jugal; *bsp*, basisphenoid.

All the figures are reduced copies of life-sized drawings, made by Miss Mary Wellman and the author, from specimens in the University of Kansas Museum.

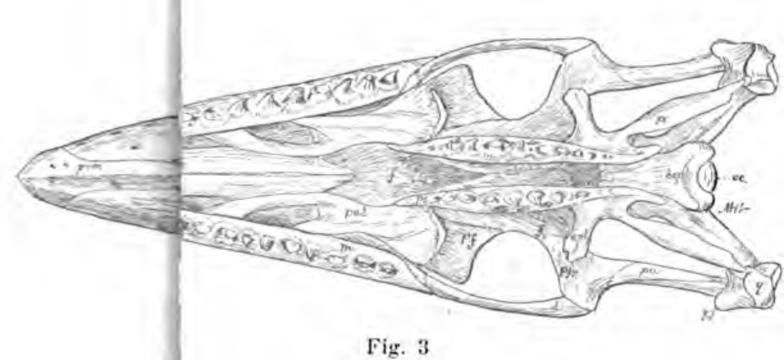


Fig. 3



Mary H. Wellman, ad nat. del.

S. W. Williston, direx

PROSPECTUS.

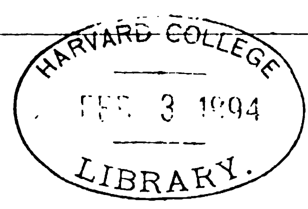
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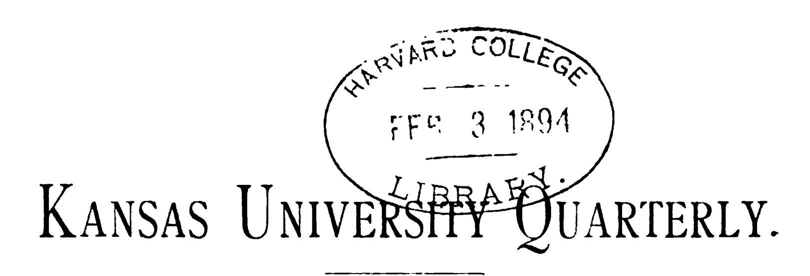
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VOL. II. JANUARY, 1894. NO. 3.

Report on Field Work in Geology for Season of 1893, by the Department of Physical Geology and Mineralogy, University of Kansas.

CONTENTS.

Prefatory Note.

ERASMUS HAWORTH.

By an act of the board of Regents of the University of Kansas, a small appropriation was made to defray field expenses while prosecuting geologic work. By a provision of the faculty, students of the University and others who avail themselves of the privilege may receive credit for field work the same as for other work performed, provided it is considered sufficiently meritorious by the head of the department under which the work is done. In this way it was hoped a much greater amount of valuable work could be accomplished than would otherwise be possible, since advanced students in this and other institutions, and teachers from different parts of the country who

were wishing to do original work in geology, would have an opportunity to do such work under the guidance of the University, and would also be furnished a medium of publication, a point of no little importance.

During the summer just past, such hopes were realized to a gratifying degree. A class of three was organized by the department of physical geology and mineralogy, consisting of M. Z. Kirk, (B. S. Penn College), formerly connected with the Missouri Geological Survey, W. H. H. Piatt, senior in the University of Kansas, and C. E. McClung, Ph. G., and student in the University.

It was decided to commence operations in the southeastern part of the state, and to devote the season principally to stratigraphic work. The stratigraphy of the Coal Measures of Kansas has been known in a general way for years, but detailed information on the subject has not been published. Prof. Hay has made a few sections and done a great deal of work in that part of the state, but his drawings and writings are still unpublished by the U. S. G. S., under whose auspices his work was principally done. Prof. O. St. John has also done a large amount of work in the Coal Measures of Kansas, but unfortunately for science the greater part of this has been done for private companies and corporations, so that the results of his labors have not been made public. The various sections published by the state board of agriculture in their reports, from time to time, are largely diagrammatical, and therefore lack the element of exactness desired for detailed work. It was, therefore, necessary to begin the work in stratigraphy about the same as though nothing had been done previously.

The formations in eastern Kansas in general dip gently to the northwest, while the surface rises in that direction at the same time. Any given formation, therefore, which may be exposed at a given point will be found to pass beneath the surface to the northwest sooner or later if it is sufficiently persistent in extent. As one travels in that direction he will accordingly be passing up a flight of gently inclined stairs, each step of which is exposed for a few miles only, until it passes beneath the one overlying it.

The bluffs on either side of the Neosho river afford an excellent opportunity for the study of these systems of rocks, for the stream passes approximately at right angles to their strike almost entirely across the Carboniferous area of the state. This river was therefore chosen as the location of one of the principal sections to be made during the summer, and Mr. Kirk was assigned to the work. He began at the contact line between the Mississippian and the Coal Measures proper, followed the river to White City, and then went up

the Cottonwood river to Peabody, making an aggregate distance of 230 miles. He also made important observations on the deep borings at different points which he passed, as well as other matters of surface geology.

The Verdigris river affords another good opportunity for studying the stratigraphy of this part of the state. It is not so long as the Neosho, but like the latter passes from the younger to the older rocks. Its general direction is almost parallel with the Neosho, from which it is distant from thirty to forty-five miles. Mr. Piatt was entrusted with the task of making a section up this stream, which he did in a very satisfactory manner from the state line to Madison, a distance of ninety-three miles. Later he did considerable in the way of correlating the limestone systems of the two rivers, and in tracing the southeastern limits of two of the principal limestone formations. He also made observations on such deep wells as lie within his field.

In order to fully determine the stratigraphy of the eastern half of the state many sections must be run in different directions, and the oftener such sections intersect, the greater the possibility of checking, and thus rendering the work more accurate. With this in view the writer made a section from a few miles below Cherryvale along the Atchison, Topeka & Santa Fé railroad to Lawrence, and from Ottawa to Holiday, a total distance of 168 miles. This section crosses the Neosho river section at a sharp angle, at Iola, so that a portion of the two are very similar.

Mr. McClung devoted the greater portion of his time to a study of the coal district in Cherokee and Crawford counties. He also, with the assistance of Mr. Kirk, ran two sections across the coal fields from southeast to northwest, aggregating about seventy-five miles. He made a provisional map of the coal mining district, locating the various shafts and stripping-pits. The subject is such an important one, however, that it is thought best not to publish the results until further work can be done.

During our first summer's work, therefore, nearly 600 miles of sections were made and much other work accomplished. This report should be looked upon as preliminary, and it is offered subject to correction, although in the main it is believed to be substantially correct.

The general plan of work adopted for the coming summers includes the making of additional sections along the Osage, Pottawatomie, Kansas, and other rivers, with sufficient cross sections to furnish all the checks necessary. It also includes the gathering of fossils, and of economic products, in order that we may ultimately have a complete survey of this part of the state.

Relative Value of Limestone, Sandstone, and Shale, for Stratigraphic Work in Kansas.

ERASMUS HAWORTH.

For the purpose of stratigraphic work in eastern Kansas the limestone systems are much more important than all others combined. This is due to the great regularity of the limestone horizons, and their persistence in lateral extent. From tne nature of their formation this might be expected, yet the difference in continuity between the limestones, and the sandstones and shales is greater than in many other parts of the world. Numerous instances are known of limestones not more than ten or twenty feet thick having a lateral extent of from fifty to a hundred miles, while the sandstones rarely extend continuously more than a fourth the distance.

Again, the sandstones and shales grade into each other with the greatest frequency, much more so indeed than either of them grades into the limestone. The latter occurs much less frequently than seems to obtain farther east in Missouri*, or farther north in Iowa†, yet it is not wholly unknown.

A few examples of the persistency and extent of the limestone may be interesting. The Oswego limestone, numbered 2 in Mr. Kirk's section, extends from an undetermined distance in the Indian Territoıy below Coffeyville to beyond Fort Scott on the northeast, a distance of over fifty miles. Passing northeast from Oswego it rises so as to cap the high hills north of Pittsburg, then falls to the much lower level of the environs of Fort Scott. How far beyond the limits of the state it extends is not known, but it undoubtedly reaches many miles into Missouri.

The Erie limestone, numbered 3 by Mr. Kirk, occurs about 100 feet above the Oswego limestone. It covers the high land between the Neosho and Verdigris rivers, constituting the upper limestone in the vicinity of Independence, whence it extends south beyond the state line. It reaches northeast probably to the Missouri line, although it has not yet been traced that far. Over the southeastern portion of its exposure it is generally quite thin, having been worn to a feather edge by surface erosion. But farther back it becomes a great limestone system, occurring in beds fully 60 feet thick along the bluffs of the Neosho above Shaw. It is very abundant in the vicinity

*Mo. G. S. Rep., Preliminary Report on Coal, Winslow, p. 24.
†Ia. G. S. Rep., Vol. 1, 1892.

of Erie, is the lead and zinc bearing rock at the prospect borings north of town, and has been provisionally named the Erie limestone.

First above the Erie limestone, at a vertical elevation of nearly a hundred feet, is the Iola limestone, numbered 4 in Mr. Kirk's section. This is the heavy beds exposed south of Iola for miles, and in which the Iola quarries are located. It extends westward to Benedict, and down the Verdigris river some distance, according to Mr. Piatt. It crosses the stream and extends an unknown distance to the southwest. To the northeast it covers a large area, and reaches to Lane and Fontana, in Kansas, from whence it crosses over into Missouri, constituting one of the best defined and most persistent limestone systems in the eastern part of the state.

It will thus be seen that not only an occasional limestone system is persistent, but that a majority of them are so, the three just mentioned being the first three, save one, above the lead and zinc bearing Mississippian formations in the extreme southeastern part of the state. It was decided early in our work that it was of first importance to get these great limestone systems located and accurately mapped, after which the more varying sandstones and shales can be studied to any degree of detail desired for each particular locality. Therefore the drawings of the sections accompanying these papers represent the limestone only. They represent accurately the location of the southeastern outcropping of each system, and the place where each passes beneath the surface, but being drawn to so small a scale there is necessarily some inaccuracy in the representation of the thickness and vertical distance between two neighboring systems. This error, however, is not great. The greatest error in the drawings is in the angle of dip, which in no case was measured accurately, either in the field or in making the drawings. The dip is so small that nothing less precise than actual leveling by means of the engineer's transit can be of value. This has thus far been impractical, very satisfactory results, however, have been obtained by observing where the two limits of exposure are located, and determining from maps the distance and variation of surface levels, from which the number of feet dip per mile is readily calculated. In this way it is found that the general average of dip where studied is approximately nine feet to the northwest. Local variations sometimes seem to contradict this, so that the statement must be made in a general way.

The sandstone formations have no such continuity. Formed along coast lines and near the shores of the ancient seas they necessarily will be much more limited in transverse directions, and longitudinally will also be confined more or less to the neighborhood of streams which brought the sand from dry land. Many instances are known

of heavy beds of sandstone which only extend a few miles in any direction. Those in the vicinity of Lawrence serve well for an illustration.

At Oak Hill Cemetery, east of Lawrence less than two miles, sandstone is very abundant. A considerable hill is left behind after the valley all around is eroded to a much lower level. Yet the sandstone extends in no direction, excepting the south, a distance of a mile. It has gradually graded into shale which has yielded to erosion, leaving a valley behind. A similar and equally heavy deposit of sandstone is laid bare by erosion on the south bank of the Wakarusa south of the University. Its extent is greater than the Oak Hill sandstone, but it continues only a few miles, while limestones a fourth as thick cover counties.

A Geologic Section Along the Neosho River from the Mississippian Formation of the Indian Territory to White City, Kansas, and Along the Cottonwood River from Wyckoff to Peabody.

ERASMUS HAWORTH AND M. Z. KIRK.

[These sections are represented in figures 1. 2 and 3, Plate IV, and their location is shown on the map. It was thought best to let the drawings represent straight lines, rather than the meanderings of the streams.]

a, THE NEOSHO RIVER SECTION.

The northwestern limit of the Mississippian* or Sub-carboniferous formation along the Neosho river was not definitely determined. It may be at a point about fourteen miles below the south Kansas line, at the top of a sandy limestone system which now and then assumes a shaly aspect, or it may be some miles below Miami town, a little further down the river. Nothing exactly corresponding to this formation is known within the state along the contact line between the lead and zinc bearing limestone of the Mississippian and the Coal Measures, although frequently a sandstone seems to lie at the base of the latter. Above this point for fifteen miles or more nothing is exposed along the river bluffs but shale, which here and there assumes so silicious a character that it would almost do to be called a sandstone; and a few seams of coal which usually are so thin they have but little commercial value. The first limestone system encountered is a thin bed found about seven miles below Oswego,

*The term Mississippian was suggested by Prof. H. S. Williams, U. S. G. S. Bul. 80, p. 135, 1891, to replace the older term Sub-carboniferous. For many reasons it seems preferable, and has already been adopted by Winslow, Keyes, and other geologists in their writings on different phases of the geology of the Mississippi valley.

although on the hill-tops it undoubtedly reaches farther south This limestone system has been named the *Swallow limestone* by Dr. Newlin of Oswego on account of its having been described by Prof. Swallow in 1854. For the present, at least, we may employ the same term to designate it. The Swallow limestone is not very prominent in the adjoining country, and in many places either is concealed from view by the soil, or entirely fails to exist. Above this no limestone is found until the the Oswego limestone is reached in the vicinity of Oswego.

The Oswego limestones are nearly 500 feet vertically above the lead and zinc bearing limestones of Galena. This great distance is principally occupied by shale, although in places sandstone is abundant, and also the Weir City-Pittsburg coal beds are contained within it. This is perhaps the heaviest bed of shale in the state, at least it is nearly three times as thick as any other bed included in this section. So far as known to the writers it has never been designated by any distinct name. We therefore suggest that it be known under the name *Cherokee shales*, and that the term be applied to all the shales above the Galena limestone and below the Oswego limestone, unless the Swallow limestone should prove to be more extensive in Cherokee county than now seems probable. Should such be the case the term should apply only to the shales below the Swallow limestones.

The Cherokee shales have but few properties different from many shales in other parts of this and other states. They vary considerably in color, some of them being almost ashy white, while the other extreme is reached in those unusully rich in carbon, which of course are of the usual black. They are generally poor in fossils, yet in places fossil plants seem to be abundant. They contain many beds or seams of coal, some of which are only a few inches in thickness, while one of them is the thickest known in the state, the Weir City-Pittsburg coal. The smaller beds have but little lateral extent, and two or more of them often occur within a few feet of each other vertically. The Weir City-Pittsburg vein extends many miles southwest and northeast, but seems to have quite a narrow transverse limit. Along the Neosho river more than a dozen distinct beds of coal were observed, some of which are thick enough to justify being worked locally, but none of which admit of extensive operations. The Cherokee shales are interbedded with sandstones in places to such an extent that large deposits and persistent strata are met with. The most extensive of these are the sandstones which outcrop along Brush creek east of Columbus. The same strata extend many miles to the east, northeast and southeast, forming bluffs along the Shawnee creek valley, and a system of well defined hills farther south. Beneath

the sandstone the shale is more than 200 feet thick, so that erosion has produced the configuration of surface usually found in places where a cap stratum of hard rock overlies a heavy bed of softer ones; that is, a surface composed of broad valleys with high, steep mounds and rows of hills limiting their extent. This is well illustrated by the broad, level valleys of Brush creek and Shawnee creek with the irregular hills between them, and the isolated mounds here and there adjacent to them.

Eastward, this or a similar system of sandstone extends across the state line into Missouri; but westward, it seems to gradually disappear long before the Neosho river is reached. It would be improper, therefore, to speak of it as dividing the Cherokee shales into two divisions, for this is only true in places. For convenience of referenee the name *Columbus sandstones* will be given this sandstone system, believing that it is sufficiently well defined in places to justify a distinct appellation.

At present it is impossible to say how many indistinct limestone systems there are included within the Cherokee shales. The Swallow limestone is moderately well defined below Oswego, but it has not been traced to the east to any considerable extent. In sinking for coal to the northeast of Columbus calcareous matter was usually passed through, but hardly in sufficient extent and purity to justify its being called limestone. Still, in places marine invertebrate fossils are abundant in it. Possibly it is the equivalent of the Swallow limestone, but the two have not yet been correlated.

The lateral extent of the Cherokee shales has never been determined. To the northeast they reach many miles into Missouri, and to the southwest a like distance into the Indian Territory. Westward and northwestward they have been reached by borings in different places. At Cherryvale the city well showed that over 400 feet of shale immediately overlies the Galena limestone. It is probable they extend for many miles further.

As before stated, the Cherokee shales constitute the thickest shale beds known in the state. They contain the most valuable economic products thus far discovered in the state, and deserve extended and careful study. It is hoped that by the close of another season's field work our detailed knowledge regarding them will have been greatly increased.

The Oswego limestone consists of two beds which are separated by a bed of about eight or ten feet of shale. In the environs of Oswego each is about ten feet thick, but westward they thicken considerably, so that six miles out they are 21 and 24 feet respectively, as shown in a small bore near Stover. Still farther west they seem to unite, or

else the upper one becomes immensly thick, for according to the best correlation* we can make the heavy limestone at Independence is the same as the Oswego limestone. Here there seems to be but one bed; and it is 30 or 40 feet thick. To the northeast it seems that the Oswego limestone reaches to Fort Scott, and even farther. It caps the high hills on the divide between Fort Scott and Pittsburg, reaching an altitude of fully 1000 feet above sea level. The altitude at Oswego is only 889 feet, and the distance about 30 miles, giving the rock a dip to the southwest of 3½ feet to the mile. The greatest dip is to the northwest. If our correlation is correct the dip from the highlands north of Pittsburg to Fort Scott is fully 11 feet to the mile, making one of the highest angles known in this part of the state.

The character of the two strata of the Oswego limestone is very similar. Each stratum is composed of a number of distinct layers; each one, also, is relatively rich is fossils. Brachiopods occur in considerable abundance, and also well preserved fossil coral is plentiful. The rock is a compact, solid limestone of a light buff color, and is suitable for building purposes of all kinds when it can be obtained of sufficient dimensions. In addition to the fossils it also contains flint nodules in considerable abundance.

The shale between the two strata of limestone is intensely black, the most so of any observed in the state. In many places it has little nodular concretions about the size of hickory nuts which weather out in great abundance. When broken open they seem to be homogeneous, and seem in constitution like the remainder of the shale. The black color of the shale, as well as the nodular concretions, is due of course to carbonaceous matter.

Passing up the Neosho river from Oswego one finds that the Oswego limestone is observable at or near the surface to the vicinity of Laneville, where it passes beneath the water in the river and is seen no more. We had no exact data from which to calculate the difference of levels. At Oswego the limestone is fully 120 feet above the water in the river. The distance up stream is about twelve miles. Making an estimated allowance of three feet per mile for the fall of the river we have a northerly dip of about seven feet per mile for the limestone.

Immediately overlying the Oswego limestone there is a bed of shale which in places grades into sandstone. This formation is from 75 to 100 feet thick. It is unusually important on account of the many beds of excellent sandstone it contains in different places. They are characterized by the thinness of the layers and smoothness of the

*The evidence upon which this correlation is based will be given in another division of the present article, this number of the Quarterly.

surface of the same, so that they make excellent flagging stone. In section 13, township 30 north, 20 east, on the land of A. G. Robinett, extensive quarries are opened, from which large amounts of flagging are taken to neighboring towns—Parsons, Osage Mission, and other places. Other quarries are opened near this, but are not so extensively operated.

At this point the Neosho river brushes against a precipitous bluff on its west bank at which place a splendid section may be observed, as follows:

Surface soil and gravel, ...	5 feet.
Limestone, ...	8 "
Yellow to red sandstone	8 "
Bluish sandstone, ...	45 "

It is the latter that furnishes the best flagging stone. To the northeast the same formation includes the famous Fort Scott flag stones which are shipped so extensively over the state. At each place the flag stones are quite shaly, so that they lack a great deal of being pure sandstone. At other places they become more pure; the layers become thicker and would furnish good dimension stone. Mr. Josiah Kimmel has opened such a quarry in section 23 of the same township.

Although sandstone seems to be so abundant, yet it should be clearly stated that the predominant part of the system is shale, so that it is properly called a shale formation. Within five miles of the excellent flag stone at the Robinett place the whole vertical distance of the formation is shale. This system will be called provisionally the Laneville shales, with a probability that the name will ultimately be changed to that of some point more centrally located. The flagging stone on the Neosho river may be called the *Robinett flags* while of course those at Fort Scott will retain the name of the city near which they occur.

Immediately overlying the Lanevile shales one finds an important limestone system which is only a few feet thick along its southeastern limits where it is found capping the highest hill tops, but which increases in thickness to the northwest until it reaches a maximum of 60 feet between Shaw and Austin. The difference in thickness is largely due to the planing off of the upper surface by weathering, producing a wedge-shaped mass. It may be called the *Erie limestone*, on account of its great abundance in the neighborhood of that thrifty little town. To the southwest it covers the high ground between the Neosho and Verdigris rivers to an unknown distance southward, but probably across the south line of the state. It is probably the upper limestone system around Independence, that covering the hill tops,

and crossing to the west of the Verdigris river. To the northeast it probably passes out of the state, but it has not been traced that far. On the whole it constitutes one of the most extensive and most important limestone systems in the state. No other one that will at all compare with it is known above the Galena limestone excepting the Iola limestone, and it is doubtful whether this is any heavier.

The quality of the Erie limestone is varied. Where it is weathered it seems quite porous, due to the unequal degree of solubility of the rock. In protected places it is firm and compact, and would make an excellent building stone. At one place in a railroad cut between Shaw and Erie the rock assumes a wonderfully brecciated texture. The extent of such a texture was not determined, but it must be quite limited, for nowhere else was it observed.

Above the Erie limestone there is another system of shales and sandstones which in places reach a thickness of nearly 150 feet, but which along the Neosho river section possibly does not exceed 100 feet. It reaches its maximum thickness in the vicinity of Thayer, where it is estimated to be 150 feet thick. It extends from below Osage Mission to above Chanute, which town may well give it a name, so that it may be called the *Chanute shales.* Here, as elsewhere, sandstone appears and disappears with great readiness. Around Thayer the sandstone occurs in heavy beds, some of which produce excellent building material.

Below the sandstone at Thayer a seam of coal is found of sufficient thickness and quality to justify its being worked extensively enough to furnish fuel to Thayer and the surrounding country.

About the Chanute shales lies the heavy system of limestone in which the Iola quarries are situated, the so-called Iola marble. For this reason it may be called the *Iola limestone.* Its southernmost appearance along the Neosho river is on the hills about Chanute, where it occurs at the very summit, being worn to a thin stratum by erosion. It thickens rapidly to the north until at Iola it is 30 or 40 feet thick. Laterally the Iola limestone has a great extent, having been traced by Mr. Piatt to beyond the Verdigris river to the southwest, and almost to the state line on the northeast. The character of the rock is remarkable, particularly regarding the unusually thick layers it produces, in this respect surpassing anything else known in the state. On this account rock of any dimension can be obtained from it, as is practically demonstrated at the Iola quarries.

Above the Iola limestone lies a bed of hard, sandy, brittle shale, which has a thickness of apparently 75 feet, although immediately in Iola it may not be quite so heavy. Above this another limestone system begins, and is first seen below Iola in a stratum of four or five

feet capping the bluff just above the quarry in the Iola limestone. Farther up the river it increases to a thicknes of 15 or 20 feet, but is nowhere a heavy limestone system. It is abundantly exposed at the little railroad station, Carlyle, five miles north of Iola, and will therefore be called the *Carlyle limestone*. From here it extends southwest, is well represented along the Neosho river at Neosho Falls, and passes beyond to the southwest. It remain visible for about four miles up the river from this place where it disappears beneath the water in the river.

Above the Carlyle limestone there is a heavy bed of shale and sandstone reaching nearly 150 feet in thickness. It is abundantly exposed around Le Roy, and may be called the *Le Roy Shales*. In some places sandstone is very abundant. South of Moody station a hill over a hundred feet high is nearly all sandstone, and in other places it is equally abundant. This is undoubtedly the same system of shales lying between the Carlyle and Garnett limestones farther east in the vicinity of Colony.

Above the Le Roy shales a system of limestone sets in, which is first seen along the river on the high hill-tops about five miles above Neosho Falls. It consists of two strata separated by 8 or 10 feet of shale. The rocks are hard and compact, and would make durable building stone. In the vicinity of Burlington a number of quarries have been opened, some of which have produced a large amount of building stone. The strata disappear beneath the surface a short distance above Burlington.

These strata correspond in every respect with the two limestone strata lying at Welda and continuing to Ottawa, as is shown by the section from Cherryvale to Lawrence, published in this issue of the QUARTERLY. There is little room for doubt that the two are identical. Grouping the two strata into one system, it may be called temporarily the *Burlington limestone*, or the *Garnett limestone*, leaving the ultimate choice of a name to some future time.

Above the Burlington limestone there is from 75 to 100 feet of a shale formation which is very sandy in places, producing an impure sandstone. It extends for miles above Burlington, producing the wide bottom lands in that vicinity. Above this shale there is a thin limestone system, not over six feet vertically, which is seen on the hill-tops south of Burlington. It is visible along the railroad all the way from Burlington to above Strawn, and may be called the *Strawn limestone*.

Overlying the Strawn limestone is a system of black shales 60 or 80 feet thick, which contains much less sandstone than the shale bed last described. A section of it may be seen just south of the railroad bridge above the station.

The next formation met with in ascending the river is a limestone system from 12 to 15 feet thick, which is first seen on the hill-top south of Strawn and which passes under the surface a short distance above Hartford. It is number 8 in figure 2 of plate IV. The rock is very porous, and probably has but little economic value. Above limestone number 8 there is a system of sandy shales about 75 feet thick, but which covers comparatively little surface along the line of this section on account of the ground rising so rapidly above Hartford.

At the church just south of the junction of the Cottonwood and Neosho rivers limestone number 9 is seen on the top of the hills, from which place it extends up the river almost to Emporia before passing out of sight beneath the surface. It is exposed at the end of Sixth Avenue four miles east of Emporia and at the Humphrey ford in section 28, township 19, range 12. It forms a vertical wall over 20 feet high. The same limestone system is also exposed on the north side of the hill north of Emporia. It has been quarried extensively in different places, and fairly good dimension stone has been obtained. It is also quite noted for the large and well preserved fossil crinoids which it contains. On account of its great exposure in the vicinity of Wyckoff, it may be called the *Wyckoff limestone.*

Above the Wickoff limestone there is a bed of shale from 50 to 60 feet thick which carries a great deal of sandstone. It covers the whole country for miles around. Immediately on top of this is the limestone system numbered 10, in plate IV. This limestone is first observed on the hill-tops about four miles south and one mile east of Emporia. It is also exposed on top of the hill just south of the church in section 33, township 19, range 11, at which place the whole system is only about 5 feet thick. It continues westward a few miles, but as the surface is rapidly rising it soon passes under ground. It is last seen about two miles northwest of Emporia. It is characterized by being so full of seams that no large pieces can be obtained. Mr. Curtis has a quarry in section 29 of the township just mentioned. He finds a considerable market for the rock in Emporia, where it is used for walling cellars and wells and for making other structures for which large dimension stone is not required.

Above limestone number 10 we found a thin system of shales measuring about 40 feet in thickness. On top of this is limestone system number 11, which is first seen on the hill-tops from four to five miles northwest of Emporia. It is composed of two different strata, each of which is less than 2 feet in thickness. They are separated by about 4 feet of shale, which is not represented in the drawing. The lower stratum produces a 16-inch layer of solid white limestone, which is extensively used for bridge building and other purposes.

After passing another 40-foot system of shales, limestone system number 12 is met with about five miles from Emporia, from which place it skirts the hills all the way to Dunlap. It is composed of two distinct strata, each about 5 feet thick, separated by about 15 feet of shale. Neither of them is of any special economic importance, the lower one in particular being a fine-grained compact rock so full of vertical seams that it is rendered useless for building purposes.

A 30-foot bed of dark sandy shale now takes us to limestone system number 13, which is considered the equivalent of the famous Cottonwood Falls limestone. Along the Neosho river it is exposed from the hill-top south of Dunlap to Council Grove. As this limestone will be described more in detail in connection with the section along the Cottonwood river, we will leave it for the present.

Above the Cottonwood Falls limestone we find a sandy shale about 30 feet thick, above which is limestone number 14, a comparatively unimportant system not more than 8 feet thick, which is exposed for about five miles partly below and partly above Council Grove.

After passing 14 feet of dark sandy shale*, limestone number 15 is reached on the hill-tops above Council Grove. This is an important limestone system, which extends to the northwest almost to Parkerville. It is over 20 feet thick, and is particularly noted for carrying so large an amount of flint both here on the Neosho river and on the Cottonwood river, where it is so well developed. Possibly it is the equivalent of the flint-bearing limestone at Fort Riley, which is less than twenty-five miles to the northwest.

Passing 40 or 50 feet of shale, limestone number 16 is reached, which is the last in this section. It is from 6 to 10 feet thick, is a soft white rock with even texture, and has been used extensively for building purposes in Parkerville. Its southeastern limit is about seven miles below Parkerville, from which place it extends to a few miles above the town. No other limestone was seen between this and White City. Seventy-five feet above number 16 an 18-inch layer is reported to have been found in wells, but this was not verified. If such a rock exists it is near the top system on the divide between the Neosho and Kansas rivers, for White City is almost on the divide.

b, THE COTTONWOOD RIVER SECTION.

Let us now return to the mouth of the Cottonwood river, near Wyckoff, and trace the section along that stream. Near this place the distance between the two rivers is so short that we are practically

* By some mistake the thickness of all the formations above number 13 in this section was greatly exagerated in the drawing, which was not noticed until too late for correction.

sure limestones numbers 9, 10, and 11, with their intervening shales, of the Neosho river section, are identical with the first three limestone systems encountered in passing up the Cottonwood river. The system numbered 12 first makes its appearance east of Cottonwood Falls a few miles, and is quite prominent at the famous stone quarries at that place. The principal quarries are located in number 13, which first appears in the neighborhood of Ellinor, three or four miles east of the quarries. At the Retticker Bros.' quarries, situated two and one-half miles east of Cottonwood Falls, we have the following section: Beginning on the hill-top we find about 30 feet of soil, gravel, and shale, in the latter of which marine invertebrate fossils are unusually abundant. They weather out on the hill-side above the limestone. Below this is limestone number 13, composed of two layers, the upper one of which is 2½ feet, the lower one 3. Each layer is remarkably uniform and particularly free from vertical fissures. These properties render the stone the most valuable for building purposes of any thus far extensively operated in the state. It is possible to obtain masses of almost unlimited size with a thickness of either 2½ or 3 feet. By splitting or sawing the layers, flagging stone of any desired thickness and 20 or 30 feet long can easily be obtained.* Below number 13 there is about 30 feet of shale, but it is not nearly so silicious here as along the Neosho river. Below this is the upper stratum of number 12. In character the rock is quite similar to number 13, and has been quarried considerably, but the operations were finally abandoned on account of the thinness of the layers and the large amount of stripping necessary. Below another 9 or 10 feet of shale the lower limestone of this system is found. It differs radically from the upper one in being much finer grained and more compact in texture, and in having so many vertical fissures that it is impossible to work it into dimension stone. Yet for ballast and for structural purposes where small pieces are wanted it is one of the most valuable in the state on account of its durable qualities. It has a sub-conchoidal fracture, a dark bluish-gray color, and its blocks are so angular that it is locally known as "joint rock."

On the north side of the Cottonwood river these limestone systems can be traced for miles below Strong City. They disappear beneath the level of the railroad track in regular order, number 13 passing out of sight a short distance above Strong City.

After passing from 20 to 30 feet of shale limestone number 14 is seen on the hill-side northwest of Strong City. It is here about 4 feet thick, and is a much better quality of stone than that produced from

* The plant at this quarry is well suited for the extensive operations which the good quality of the stone has brought about, but space will not admit a lengthy description.

number 14 along the Neosho River. It has been quarried quite a little near Strong City, but such quarries are now almost abandoned. It disappears beneath the surface near the ford close to Evans Junction.

Another system of bluish shale 15 or 20 feet thick takes us to limestone number 15, which is about 40 feet thick where it is exposed along the bluffs of the Cottonwood river between Strong City and Elmdale. This is probably the equivalent of number 15 in the Neosho river section, which, it will be remembered, was the heaviest limestone bed found above the Iola limestone. On the Cottonwood river it is much heavier than along the Neosho, but is less characterized by flint nodules than the latter, although even here there is present an unusually large amount of flint. The stone is of sufficient purity to make a good quality of lime, which has resulted in the establishment of lime-making industries at different places. Near the top of the system one layer is about 12 feet thick, and would make a valuable building stone were it not so filled with flint nodules that it cannot easily be worked. This system passes out of sight beneath the surface near Crawford.

Another shale bed 30 or 40 feet thick brings us to limestone system number 16, which may be seen along the hill-tops a short distance east of the Elmdale mill, and continues to less than a mile above Clements. It has been quarried locally in different places, but is not a very desirable stone.

Number 17 begins below Clements and ends above Cedar Grove. It consists of two strata separated by a thin bed of shale. The lower stratum is thin and unimportant; the upper one reaches a thickness of 16 feet, and contains a number of different quarries, but is so soft it has little value.

Above number 17 some 30 or 40 feet are occupied principally by sandstone at this place, above which limestone number 18 is found on top of a high bluff between Cedar Grove and Florence. Where it first appears it is about 4 feet in thickness, but in the vicinity of Florence it has increased to 12 or more feet. It has been quarried in different places to a limited extent.

Above this, two other limestone systems are seen, numbers 19 and 20, the first of which is 30 or 40 feet above number 18, and the second almost an equal distance above the first. Each is an unusually thin system. Number 19 is especially worthy of mention on account of the large amount of flint nodules it contains. Each begins east of Horners, and ends between Horners and Peabody. Beyond these no limestone was found below Peabody, the end of the section.

The combined sum of the strata from our starting point in the Indian Territory to Peabody, a distance of 150 miles straight, is 1963 feet, if we take the average thickness given in the foregoing pages. Of this, 327 feet represent the total limestone, and 1636 the shales and sandstone. This gives the ratio of limestone to shales and sandstone as 1 : 5, or of limestone to whole thickness 1 : 6. The elevation of Peabody is about 637 feet above our starting point. Subtracting this from the total thickness, 1963 feet, we have 1328, which represents the total dip of the strata in this direction, which is almost exactly 9 feet to to mile.

It is exeedingly probable that the surface of the Misssissippian formation has a greater depth than this at Peabody, for borings at numerour points in the state indicate that the nonconformity at the surface of the Mississippian results in the existence of different formations to the west which do not outcrop anywhere to the east. This subject is discussed in another division of the present paper in this number of the QUARTERLY.

A Geologic Section along the Verdigris River from the State Line to Madison.

ERASMUS HAWORTH AND W. H. H. PIATT.

[This section was made along the Verdigris river from the state line to Madison, a distance of about ninety miles. Figure 1, plate V., represents the elevation on the colored line in blue along the Verdigris river shown on the map. Instead of following the meanderings of the stream with the drawings, it was thought best to follow straight lines.]

It is reported that a limestone which is 60 or 75 feet below the first one observed by us may be found in the river below the state line. At the state line the surface is covered with a heavy bed of shale which, in the adjoining hills, is about 150 feet thick. Below the shales a heavy limestone exists which is only a few feet thick where first observed, but which increases to nearly forty feet thick in the environs of Independence, and which we will temporarily call the Independence limestone.

The shale beds above this have a great deal of sandstone in places, so much so indeed that the sandstone becomes more noticeable than the shale. Near the top of the system a six-inch bed of coal exists, which probably extends to beyond Independence; or if not the same one then other similar beds occur. Heavy sandstone overlies the coal, and a limestone system caps the hills above the sandstone. This limestone system extends from a few miles above Coffeyville to

the vicinity of Altoona, gradually occupying lower and lower positions until it finally disappears beneath the surface south of Benedict about three or four miles.

Throughout almost the whole of this distance the space between the two limestone systems is largely occupied with heavy beds of sandstone. In fact the sandstone is so abundant and rises into such high hills in numerous places that it becomes a little difficult to decide at times just what the relation is between the two.

Above the second limestone is another system of shales, which contains much sandstone. On top of this and beginning on the hill-tops around Benedict a third limestone appears. This was traced to the northeast by Mr. Piatt and Mr. Kirk and determined to be the Iola limestone, with which it agrees in all of its essential qualities. It is a heavy deposit, abour 35 or 40 feet thick, composed of unusually thick layers, and in many other ways resembles the Iola limestone, thus showing that with this system, at least, a lateral extent of twenty-five or thirty miles makes but little change in a great limestone system.

With the identity of the limestone at Benedict and Iola established, we may now attempt to correlate the two systems already passed north of the state line. Down the river from Benedict the first limestone met is the one capping the hills from Altoona almost to Coffeyville. It lies about 100 feet below the Benedict-Iola system, and is a remarkably heavy system, measuring from 50 to 60 feet thick in some places. This is particularly true at Table Mound, a very interesting elliptical-shaped mound about 175 feet above the surrounding valley. It is located northwest of Independence a little too far to be represented on the drawings of this section. On top of this mound the limestone is fully 50 feet thick. Everything, therefore,—its position, character, distance below the Iola limestone, etc.,—indicates that it is the Erie limestone, the same as that capping the mounds south of Cherryvale.

Below this again we have a heavy bed of shales and sandstone from 80 to 100 feet thick,—in some places reaching 125 feet,—when a heavy bed of limestone is reached which, it seems, should be correlated with the Oswego limestone. Here the character of the rock is decidedly different from the rock at Oswego, but from its relative position it must be the same, or some intermediate system which does not crop out towards the east. The latter suggestion is made on account of the fact that deep borings at Cherryvale and Mound City show conclusively that a number of limestone systems do exist at those places, not found along the Neosho River. It will therefore require a great deal of work and careful discrimination in the study

of these underlying strata to settle such points. At present we feel safe in correlating the Altoona limestone with the Erie. But regarding the Independence limestone we can only suggest that it is the same as the Oswego limestone, without feeling sure about it.

Above the Iola limestone we find a bed of shale about 60 feet thick, above which there is a thin bed of limestone characterized by its unusually compact and fine texture, conchoidal fracture, and blue color. It is exposed along a deep railroad cut which is known locally as the "blue cut," in allusion to the limestone. The nature of this limestone and its distance above the Iola system strongly indicates that it is the Carlyle limestone.

Above this there is a heavy bed of shale covering a large amount of sandstone. This is about 125 feet thick, possibly a little more. At its summit a little vein of coal is found. Above this a limestone is found which possibly corresponds to the Garnet-Burlington limestone. We recognize the danger in attempting to correlate such light bodies of limestone when so widely separated as are Toronto and Garnett or Ottawa. Still it is fairly well established that this system extends to Burlington almost unchanged, and if not to Toronto it must disappear rather suddenly, and another system appear in about the same place possessing properties similar to those of the Burlington-Garnett limestone.

Above the Toronto limestone we have 75 feet of sandstone and shale, then another limestone system exposed on the hill-side around Virgil. In the same hills we have another 75 feet of sandstone and shale, and at the summit a limestone system which also caps the hills at Hill Top. These limestones are thin, and relatively unimportant. Their positions are well illustrated in figure 1, plate V.

About half way between Hill Top and Madison another unimportant limestone system appears, but soon passes under the surface. In the hills at Madison four distinct strata of limestone occur separated from each other by from 20 to 30 feet of shale. Underneath the second one of these there is a thin layer of coal, but it is not of any considerable economic importance.

Evidently a summing up of the relative amounts of limestone and sandstone and shale here would show a larger proportion of limestone than was obtained in the Neosho river section, for it includes the three heavy systems,—the Oswego, the Erie, and the Iola,—and reaches only a relatively short distance above the latter.

In thus hastily giving a brief outline of the rock formations as they are seen in passing up the river from Coffeyville to Madison, no attempt has been made to give more than a general description of the different formations. But we trust that by mapping them as they

occur, and correlating a few of them with well known formations in other parts of the state our labors may lay a foundation serviceable to others, or to ourselves at some future time, should a detailed study of the section be made.

A Geologic Section along the A. T. & S. F. R. R. from Cherryvale to Lawrence, and from Ottawa to Holliday.

ERASMUS HAWORTH.

[This section is located along the railroad line. The surface contours are taken from a condensed contour kindly furnished by the chief engineer of the road, and represent the level of the rail.]

a. THE CHERRYVALE-LAWRENCE SECTION.

To the south, southeast, and southwest of Cherryvale stand a number of isolated mounds which rise from 125 to 175 feet above the surrounding valley. The summits of such mounds are flat, the sides steep and even, so that the mounds appear to be steep, truncated cones. The first one south of town was examined and found to consist of a great mass of shale reaching from the bottom to the top, and is covered with a thin layer of limestone not more than two or three feet thick. The limestone shows that it has been greatly eroded, and the peculiarly shaped irregular surface indicates that the erosion was produced by the slow process of weathering, rather than by the rapid action of mechanical agents.

The sides of the mound are steep, so much so that the cow or the horse could hardly ascend them. The wells are strewn with partially decayed shale and fragments from the limestone at the top, in some places so fresh and abundant that vegetation has not yet gotten a start. The mounds in the vicinity are similar, differing principally in size and shape. From an occasional one the limestone is entirely gone, and the sharp apex of the hill shows that its protection has not long been missed; others are more rounded, indicating that the limestone has been longer removed.

From various lines of correlation it is decided that this limestone capping the mounds south of Cherryvale is the Erie limestone, numbered 3 in the Neosho river section. It corresponds to it in position, general physical and lithologic properties, as well as in fossil contents so far as determined.

A hundred feet or more below this another limestone is exposed along the railroad. It dips gently to the north, so that the down grade of the track towards town does not place it below the limestone. In the town different borings have shown that it underlies all Cherry-

vale, usually but a few feet below the surface. As the grade rises to the north the Erie limestone is again seen for two or more miles along the road to the south of Morehead, after which it passes out of sight and is seen no more along the line of the road. What is assumed to be the same rock is exposed in the river east of Chanute. This latter is known to be the Erie limestone. The dotted lines in the drawing (figure 2, plate V.) show how well this accords with the facts of topography.

Above the Erie limestone at Morehead a heavy deposit of sandstone and shale sets in. The grade is quite heavy from Morehead to Thayer, with an elevation of 148 feet in about eight miles. In a few places thin seams of coal are met with, heavy enough to be worked locally to some extent. It is quite probable that the Thayer coal beds belong here, although lying some miles to the west. The sandstone is in heavy beds in some places, so that they furnish good building material. A number of fine buildings in Thayer are constructed entirely of them. The shales are of the ordinary kind, with no special characteristics distinguishing them from other shales.

Passing northward to Chanute we find a new limestone system on the hill-tops back of the town, which proves to be the Iola limestone, number 4 of the Neosho section. It does not appear along the railroad until after the Neosho river is crossed, the whole of the distance from Morehead being occupied by sandstone and shale. But a short distance across the river the limestone is seen, and continues very prominently until after Humboldt is passed. As this limestone has been described at length in connection with the Neosho river section, it may be dismissed here without further notice.

North of Iola about five miles a new limestone formation occurs at the little station of Carlyle. This is approximately seventy-five feet vertically above the Iola limestone. It undoubtedly corresponds to number 5 of the Neosho river section, with which it agrees in every respect. In fact, the distance from Carlyle to the line of the Neosho section above Iola is so short that there is no room for doubt on the subject. The rock is exposed in great abundance by the road side just north of Carlyle, and consists of a relatively thin system composed of different layers, the whole aggregating from eight to ten feet in thickness at this place. The rock is a compact, buff colored limestone sufficiently sound to be very durable, and therefore serviceable for ballast and structural purposes in which thin layers of rock may be used.

North of Carlyle the road bed rises rapidly towards Colony, so that the Carlyle limestone soon disappears beneath the surface. From this point to the vicinity of Welda no more limestone is exposed

along the road, but here a new system sets in, consisting of two or possibly three strata, although in the drawing they are represented as being continuous. Each stratum is composed of a number of different layers, no one of which is sufficiently thick to produce good dimension stone. There can be little doubt that this system continues northward to Ottawa, where it is exposed in the bed of the Osage river. The reasons for this view are that it can be traced almost continuously from Welda to Princeton, and that the road bed remains on top of the series from Princeton to Ottawa, at which place a limestone is seen in the bottom of the river. At several points between Welda and Richmond where the road crosses deep ravines the road bed passes below the limestone. In such cases the latter may be seen along the bluffs near by, the two different strata being separated by 10 or 15 feet of light colored shale. Farther north the shale becomes black, and in some places it looks almost like coal. The north bank of the little stream just south of Princeton exhibits the two limestone strata with the characteristic black shale between.

To the north of Princeton no limestone can be seen near the road until Ottawa is reached, where it appears in the bed of the Osage river, as above stated. As the road bed is above the rock at Princeton and also at Ottawa, it leaves little room for doubt that the limestone system is continuous between the two points.

To the west of the line of the road at different places a system of hills can be observed with limestone near their summit. This is probably the same as the upper limestone on the north bank of the river at Ottawa, but possibly it corresponds to that on the hill tops in the vicinity of Lawrence. Further work should be done before exact correlations can be made.

Again we may with a considerable degree of certainty decide that the limestone system, just described, and which will provisionally be called the Garnett limestone, is identical with number 6 of the Neosho river section which is exposed so extensively in the vicinity of Burlington, and which has already been named the Burlington limestone. The evidence upon which this conclusion is based is quite strong. In each case the system in question has a vertical distance above the Carlyle limestone of 140 or 150 feet. The system is composed of two or more strata separated by only a few feet of shale. The general character of the rock in each case is very similar, being a light buff limestone well stratified in thin layers, none of which are more than twelve or fourteen inches thick, while some are much thinner. The southeastern limit at the two points, as represented in the different drawings, are in about the proper positions to correspond with the southeastern outcropping of one rock system

provided its geographic limits are approximately parallel with those of the Iola and Oswego systems, which have been traced. We will therefore provisionally pronounce the Garnett and Burlington limestones identical.

The elevation at Colony is a little greater than at Welda, so that one can scarcely understand why the limestone does not contine southward to that point. The explanation evidently is that it has recently been removed by erosion. The sharp angle in the surface line at Colony and the steep decline to Carlyle strongly indicate that during the greater part of the period of surface configuration there was a protecting cap rock reaching from Welda to Colony, at which point it ended abruptly.

At Ottawa the Garnett limestone is found in the bed of the Osage river about 35 feet vertically below the road bed. North of the river another system is found which is relatively extensive. It may be seen by the roadside on the east side of the tracks within the yard limits, but it soon becomes covered to the north and east. The Ottawa stone quarries are located in this limestone system, which will be called the *Ottawa limestone*. It seems quite probable this is the same limestone found at Eudora, and in the Kansas river at Lawrence.

Passing north from Ottawa towards Lawrence no limestone was identified until the vicinity of Haskell Institute was reached. Here a thin stratum of about two feet was found, as shown in the drawing. The same stratum has been observed on the brow of the hill at the southeast corner of Oak Hill cemetery at Lawrence, and also on the south side of the Wakarusa. In both of these places it immediately overlies a bed of sandstone of unknown thickness. This somewhat indicates that the limestone in the Kansas river at the south end of the dam at Lawrence is the same; for it is about three feet in thickness and is said to rest directly on sandstone. The limestone and sandstone are both worn away on the north side of the river at this point. Up the river less than half a mile, near the pumping station, sandstone was reached on both sides of the stream, but no limestone is above it.

We cannot assume that this river limestone is the same as the Haskell Institute and cemetery limestone without admitting that from a point almost opposite the Institute the rock dips to the north fully fifty feet to the mile, or that it has been faulted. On account of this great difficulty the river limestone is assumed to be the equivalent of the Ottawa limestone in the drawing, which at present seems the most reasonable. Small faults, however, are known to have occurred in this vicinity. On the farm of Mr. Bowman, of Sibley, a 14-inch vein of coal was found at the depth of 19 feet. It was followed for a

few yards when it was found to drop about three feet caused by a fault with an almost vertical hade. No evidence of other faults has yet been discovered, yet they may exist.

Above the Ottawa limestone a heavy system of shale and sandstone is next reached, which, as has been stated, contains the thin limestone system exposed at Haskell Institute. As measured at Lawrence the shales are 210 feet thick. The sandstone within this system is uncertain in its extent, as sandstones usually are. The University hill at Lawrence, for example, seems to be composed of shale entirely excepting the limestone cap. Here and there the shale assumes somewhat of a sandstone appearance, but by no means enough to admit being called a sandstone. East of Lawrence less than two miles, at Oak Hill cemetery, a heavy deposit of sandstone constitutes the whole of the hill, and must be 50 or 75 feet thick. South of the Wakarusa, four miles away, another deposit of sandstone may be found which is at least 50 feet thick, and possibly much more. Also there is a great deal of sandstone in the bluff south of Vinland, along the railroad, yet only a few miles to the west none of any importance can be found along the same bluff.

As this system of shales is so extensive on all sides of Lawrence it may be named the *Lawrence shales.* It is the heaviest shale bed in southeast Kansas above the Cherokee shales, and therefore is relatively important.

In some places the Lawrence shales contain exceptionally fine fossil plants, This is particularly true in the vicinity of Blue Mound, seven miles southeast of Lawrence. Concretions of red and yellow ochre are common at Lawrence and other places, but not in sufficiently great abundance to have a commercial interest.

Coal is found in a few places in the Lawrence shales. The hill in the eastern part of Lawrence has produced some coal from a 14-inch vein. At about the same horizon the Bowman coal, already mentioned, is found to the south six miles away. How extensive this deposit is cannot easily be ascertained. It is not of sufficient thickness to pay for following it far, and as it is almost everywhere covered to a variable depth it is difficult to ascertain facts regarding it excepting where it has been exposed artificially. Little importance should be attached to so thin a deposit, for there is not much probability of its being more valuable elsewhere.

Above the Lawrence shales, and capping all the hills in the vicinity of Lawrence a new limestone system appears which is about 10 feet thick, with individual layers varying from a few inches to nearly two feet in thickness. Locally the layers sometimes run together and thicken so that they reach a maximum of four or five feet. This is

particularly noticeable in the bluffs at one point west of Lawrence, although in most places in that vicinity the lower and thickest layers do not reach more than twenty inches.

The rock when perfectly fresh and unweathered is a light blue, but in almost all instances where quarries have been opened it is changed to a light buff color. On account of the compact, fine even texture the rock is unusually valuable for structural purposes, being surpassed by but few limestones in the state. The main building, and the chemical building, as well as the new library building at the University are constructed of it, and also many handsome and durable edifices in the city.

The rock is exceedingly fossiliferous, much more so than any other one met with in this section. It contains crinoids, brachiopods, and other invertebrates unevenly distributed through it to such an extent that in certain localities they are quite remarkable. In other places fossils seem to be quite scarce, so that there is a great diversity of conditions in different localities. In allusion to Mt. Oread, the hill upon which the university stands, and where this limestone is so well exposed, it will be called the *Oread limestone.*

The north and south extent of the Oread limestone is yet undetermined. To the north it reaches far beyond the limits of this section, producing the hills or bluffs on the north bank of the Kaw river so similar to those on the south. To the southwest it probably reaches the Neosho river, although exact correlations have not yet been made. By the close of another season it is hoped such questions may be definitely determined. The southeastern limit of this system is also known for a short distance only. Blue Mound, near Lawrence, and the hills on the environs of Baldwin City seem to be the limit in that latitude, but it has not been traced farther south. Most probably the high hills to the west of Princeton are capped with it.

The peculiar character of the effects of erosion on a terrain composed of alternating hard and soft strata is well represented in the environs of Lawrence, and the resulting topography is intensified on account of the unusual thickness of the readily yielding shale between the Ottawa and Oread limestones. The protection of the hard limestone results in the formation of table lands and plateaus with broad valleys intervening, the depth of which is determined by the vertical thickness of the softer shales. Occasionally a portion of the limestone area becomes detached from the main body by erosion, breaking through between it and the main land and in this way separate hills or mounds are formed. The Blue Mound, seven miless southeast of Lawrence, is a good illustration of this.*

*This subject is better discussed in the paper on Topographic Features of Eastern Kansas which appears in this number of the QUARTERLY.

About eight feet above the Oread limestone another thin layer is found, which is exposed immediately in front of the main University building. It is only a few inches in thickness here where its upper surface has been eroded, but what its normal thickness is cannot be told, as its extent to the west has not been determined, and therefore it has not been seen with a protective covering.

On the assumption that the different formations passed in this section continue to the north at about the same thickness they individually have when observed, the following estimate would show about the nature of the section at Lawrence, beginning with the top limestone at the University.*

	Total Thickness.	Limestone.
Limestone	1 ft.	1
Shale	8 "	
Oread limestone	10 "	10
Shale and Institute limestone with heavy sandstone in places,	210 "	3
Ottawa limestone	10 "	10
Shale	40 "	
Garnett limestone and shale	30 "	20
Shale	150 "	
Carlyle limestone	8 "	8
Iola shale	75 "	
Iola limestone	40 "	40
Chanute shale	125 "	
Erie limestone	60 "	60
Shale	100 "	
Total to Oswego limestone	867 "	152

Of this 867 feet 152 are limestone, and the remaining 715 shale and sandstone. This gives a ratio of limestone to shale and sandstone of 1 : 4.7, or of limestone to total thickness of 1 : 5.7. It is interesting to note the close relation between these figures and those obtained similarly for the Neosho river section, which are 1 : 5, and 1 : 6.

The distance from Lawrence to Cherryvale by the railroad is about 125 miles, or 120 miles on a straight line. The difference in elevation is 150 feet. Subtracting this from the 867 feet it gives 717 feet, which represents the dip of the rock in this distance, or a little less than six feet to the mile upon the average.

*Two deep wells have been bored at Lawrence, one at the foot of New Hampshire street near the river, and one near the A., T. & S. F. freight depot. The record of neither well at all agrees with this section. But it must be said that they agree with each other no more closely, although located less than half a mile apart. The writer knows nothing about the reliability of the well records furnished him.

b. THE OTTAWA-HOLLIDAY SECTION.

Let us now return to Ottawa and trace the section along the railroad to Holliday.

After leaving Ottawa no limestone can be seen until Edgerton is reached. But could one deviate a few miles to the right or left from the line of the road one could find the Ottawa limestone in the lowlands along different streams. The surface of the high prairie is from fifty to a hundred feet above the limestone.

At Edgerton, however, the low valley of Wolf creek exposes the limestone for about two miles. During a portion of this distance the road bed is above the limestone, but in the lowest places it is below it. As seen here it consists of a stratum about ten feet thick, composed of several different layers, corresponding quite well with the character of the Ottawa rock.

To the east of Edgerton the surface covering again conceals the limestone for about five miles, when the low ground of a valley a few miles west of Olathe again brings it to view. Its characters here are similar to those observed in the Wolf creek valley just mentioned. Again it becomes concealed and is next seen in the northern part of the town of Olathe. From the fact that in all cases where the rock is not visible the road bed is above it, as shown in drawing, from its frequent occurrence at intervening points in the low grounds at one side of the road, and from the strong structural and lithologic resemblances, we may conclude that the limestone thus described as occurring in Olathe and points westward is identical with the Ottawa limestone.

From Olathe to Holliday there is a rapid descent, and correspondingly lower strata are brought to view. About thirty feet below the upper limestone beds in Olathe a second system sets in. It is composed of two strata, each of which includes different individual layers. The two strata are separated by a stratum of shale approximately ten feet thick. This limestone system continues along the hillside to Holliday, where it constitutes the summit of the Kansas river bluffs, and is nearly 200 feet above the road bed. The character of this system, its distance below ihe Ottawa limestone, its being composed of two strata with a thin stratum of shale between them, all point to the conclusion that this is the equivalent of the Garnett limestone; yet the distance is so great, and the rock if continuous being entirely concealed, it would be unsafe to class them together excepting in a provisional manner.

Below the above mentioned limestone system there is a heavy bed of shale about 150 feet thick, below which a third limestone system appears, consisting of two strata separated by about 20 feet of shale.

The heavy shale bed above this corresponds well with the shale below the Garnett limestone and above the Carlyle, but this system hardly compares with the Carlyle limestone. The distance is so great that it is unsafe to carry the correlation further than merely to point out the similarity and suggest the possible identity.

The lowest of these two strata is just above the road bed below Holliday, but above the station it is below the surface. It has one thick layer which possibly would render it valuable for the production of dimension stone. The upper stratum also has an unusually thick layer.

Resume of the Stratigraphy of Eastern Kansas.

ERASMUS HAWORTH.

The contact between the rocks of the Mississippian series and the Coal Measures, as exposed on the surface, is a short line in the extreme southeast part of the state not more than eleven miles long. In addition to this along a number of valleys necks of the Mississipian rocks extend to the northwest a few miles, and in other places the Coal Measure shale sare so thin they have been passed in well digging and prospecting for ores in different parts of Cherokee county. This is abundant evidence of a wide-spread nonconformity between the two rock systems, although such nonconformity is never strongly marked. By this it is meant that the angle between the two systems is a small one, producing almost parallelism of strata. It shows itself rather in the nature of surface irregularities at the top of the Mississippian series, indicating an extensive surface erosion previous to the formation of the Coal Measure rocks.

The difference in position of strata of the two series may be judged from the following data: The surface of the Mississippian rocks at the railroad bridge on Spring river, one-half mile east of Lowell station, is about 815 feet above sea level, the elevation at the station being 825. At Oswego, twenty-one miles away by an air line, the same horizon was met in a drilled well, according to data kindly furnished by Dr. Newlin, of Oswego, at a depth of 500 feet below the surface, which is equal to 389 feet above sea level. This gives a dip of 20.3 feet to the mile. At Cherryvale the same series was reached in the diamond drill hole at 1005 feet below the surface, which is the same as 165 feet below sea level, or 980 below the same surface at Spring river. The air line distance between the two points is 47 miles, which gives a dip for the surface of the Mississippian series equal to

20.9 feet to the mile. As was shown in the division of the geologic section along the Neosho river the average dip to the northwest of the strata included in that section is only 9 feet to the mile. This would make a difference of 11 feet to the mile, which represents the degree of nonconformity between the Coal Measure strata and the surface of the Mississippian series.

The drilled wells above referred to, and others in that part of the state, reveal a few very interesting points: At Cherryvale a shale system immediately overlies the Mississippian which is a little over 400 feet thick. This probably corresponds to the Cherokee shales or a part of them. Above this five or six different limestone systems were found which do not outcrop to the east, and which therefore are not represented in the Neosho river section. This makes it exceedingly uncertain regarding the position of the Oswego limestone at Cherryvale and points further west. From surface indications alone we have the right to call the first limestone below the soil the Oswego limestone, and also the lower one at Independence by the same name, as was shown in the description of the Verdigris river section. But we now feel a considerable uncertainty about the matter, for these wedge-shaped limestone systems may be partly above the Oswego limestone. Neither can we limit the Cherokee shales at Cherryvale, for some of the shales above the 400-foot system may correspond to the upper portions of the system farther east.

We must recognize the fact, therefore, that we have here a great unexplored territory hidden beneath the surface, and which can only be reached, in Kansas at least, by the drill. This territory includes the oil and gas-bearing rocks of Cherryvale, Independence, Coffeyville, Neodesha, etc., and may contain other valuable products. The well at Cherryvale passed through a 29-inch bed of coal within the 400-foot shale bed, which therefore most likely corresponds to some of the coal further east.

Unfortunately few well authenticated records of the drilled wells are obtainable. Some operators have the false notion that their financial interests would be seriously interfered with should they make public an accurate report of the well. Others were indifferent to the importance of the matter, and still others entrusted the whole subject to employes and common laborers who were careless in their work. The writer has compared records of wells near together which apparently had almost no points in common. The two bored at Lawrence, already mentioned, are good examples of inexplicable discordance. It can scarcely be believed that in a country with so high a degree of regularity at the surface as eastern Kansas has would have such a great lack of regularity a few hundred feet below the surface.

The Missouri and Iowa Coal Measures are divided by Winslow* and Keyes† into marginal and interior areas, which differ widely in their lithologic properties, a necessary result of the different conditions under which they were found. The question may well be asked: "Do the properties of the Coal Measure rocks in Kansas warrant such a division?" This can only be answered by a study of the rocks themselves, for which purpose the Neosho river section affords a good opportunity. At the base of the system we find about 500 feet of shale, with sandstone very abundant in the northeast parts, but much less abundant in the vicinity of Oswego, while the Cherryvale well shows none in its 400 feet of shale. This would indicate that the shore line was to the southeast, for the sand would be carried oceanward a much less distance than the material producing the shale. The great thickness of the shale beds also shows that the conditions were not favorable for the growth of marine animals during the time the shales were forming.

The relative thinness of the Oswego limestone along its eastern limits and the great thickness of the same (?) system at Independence implies that the deep ocean where limestone could be extensively formed lay to the west. But the heavy beds of sandstone contained within the Laneville shales reaching to the west beyond Independence indicate that this area was at that time a marginal area. Next above this we have the heavy Erie limestone reaching a thickness of 60 feet in places. This limestone bears strong evidence of having been formed beneath a moderately deap ocean. Above this we have the Chanute shales, which contain perhaps as large a per cent of sandstone as is found in either the Cherokee or Laneville shales. Still further the sandstone is as abundant along the Verdigris river as in any other locality examined, which hardly indicates a marginal area towards the east. Above this the Iola limestone is next in order, a remarkably heavy system, and one which is known to have a lateral extent of more than a hundred miles, and which probably was formed beneath a deep ocean. From this point westwards and upwards no other limestone system is known more than half as heavy as this except number 15, which has its maximum thickness away to the west beyond Cottonwood Falls. Neither is there a shale system half as thick as the Cherokee shales. The one approaching it most closely is the Lawrence shales, which carries so much sandstone. The other systems alternate with each other with much greater frequency, neither the limestone nor the shales being excessively thick, while sandstone is fully as abundant in the upper systems as in any part of the

*Missouri Geologic Survey. Report on Coal, 1891. †Iowa Geologic Survey. Vol. I. Annual Report for 1892.

shale. We must conclude, therefore, that there is not much evidence favoring the general division of our Coal Measures into two great classes, a marginal one and an interior one, for there is about as much indication of one portion being marginal as another so far as the vertical classifications are concerned. While the heaviest shale beds are at the base of the series, the heaviest limestones are also contained in the lower two-fifths, and sandstones are about as extensive in the upper half as in the lower.

Our work during the past summer was of such a nature that little evidence was gathered regarding nonconformities between different members of the Coal Measure series. One instance was noted near Independence where a channel had been eroded in the upper surface of the limestone and subsequently filled with shale. Quite possibly when careful search is made nonconformities may be found in different places sufficiently pronounced to justify a classification of the Coal Measures into different groups.

The Topography of Eastern Kansas.

ERASMUS HAWORTH.

The topographic features of eastern Kansas are entirely free from the modifying effect of the various deposits of glacial origin excepting in the northeastern part of the state, and even here the general surface features are but slightly modified by them. The topography and surface features are therefore the immediate result of erosion acting upon the stratified rocks of the country, which, as already shown in the preceding pages, are limestones alternating with shales and sandstones. The limestones resist decay strongly, the shales yield with remarkable readiness, while the sandstones have intermediate powers of resistance. The vertical distance between the different formations varies greatly, but in general the limestone beds are thin and the shale beds are thick, some of them being over 200 feet.

Let us now consider what would be the result of the action of the ordinary agents of erosion upon such a system of rocks gently inclined to the northwest, with the surface equally inclined in the opposite direction. The softer materials on the surface would soon be carried away, so that we may disregard them now. Sooner or later fissures in various places would be made through the limestone mantles, and admit the eroding agents to the tender shales beneath. The causes of the fissures may have been various. Orographic movements, gentle though they have been in Kansas, in many instances

may have produced long, continuous ones. The natural seams in the rocks in other cases probably have been followed by percolating waters which would soon dissolve out the adjacent walls and make an opening to the shales below.

After an opening was once made only a short time would be required to cut a deep channel into the soft substratum, and the formation of a river would be commenced. Should the surface be inclined from both sides toward the channel the area of the watershed would be greatly increased and the mechanical action of the water intensified. The downward wearing would progress rapidly until the next limestone stratum below was reached, provided the inclination of the surface was considerable and the rainfall abundant. But with this there would be a widening of the channel due to lateral decay. The limestone mantle would protect the shale at the upper surface, but the face of the wall of from 50 to 250 feet would gradually crumble away under the combined action of the different meteoric agents until the undermining process would cause portions of the limestone to fall. In this way the process of widening the valley continues.

Under such circumstances a river valley from one to five miles wide *per se* by no means indicates a greater flow in the stream during past time than at the present. For the widening process will not cease as long as the bluffs remain higher than the valleys. Neither is the amount of water carried by a stream an important factor, provided it is sufficient to remove the relatively small amount of solids carried into it by the lateral tributaries. After a stream has almost reached its base level, and its valley considerably widened, the process is slow, the solids being removed principally in the form of solutions, excepting at times of freshets, so that a small stream can readily carry them away. The valley of the Wakarusa near Lawrence is as wide as that of the Kansas river which is ten times as long and carries more than twenty times as much water, while different small tributaries from the south not more than six or eight miles long have valleys almost as wide. Still further, many wide valleys exist in Kansas, valleys of erosion as truly as are river valleys, which have been produced by general surface erosion almost independent of any particular stream, the countless little rivulets being sufficient to carry away the dissolved parts by the slow process of sipage, while the solids are removed during heavy rains and freshets.

Another interesting feature of the case is that every lateral tributary greatly increases the widening process. Lateral fissures in the mantle of limestone produce lateral tributaries to the principal stream. Each of these cuts its channel to a level with the main

channel and widens its borders in the same manner. In this way great valleys or embayments recede from the main stream for miles, leaving promontories or head lands between them projecting towards the river. But the serrated and scalloped bluff now has many times the surface exposed to the agents of destruction that it would have were its walls straight. As the tributary valleys continue to widen the promontories between them as continuously become narrower. During all this time the protecting covering of limestone prevents the height of the hills from being reduced, and should the broad valleys gradually become deeper the hills actually increase in relative height, although their elevation above the ocean may not increase.

The river valleys of Kansas in general correspond to the above description. The Kansas river, the Neosho river, the Verdigris river, the Osage river, and many others, all are fashioned on this general plan. If the reader will travel up or down the Kansas river between Kansas City and Abilene he will be impressed not only with the beauty of the scenery, but also by the oft repeated stencil-like recurrence of the same general features. A valley averaging four miles wide has the ever widening stream meandering from bluff to bluff always obedient to the laws of nature governing such flows. But the bluffs are not continuous. Here a broad valley almost vying with its parent in width stretches away to the north, and there a similar one extends to the south. But on either side their portals stands a limestone clad promontory as though to guard the entrance to the garden beyond, for the lateral valleys truly are gardens and threshing floors. Sometimes the tributaries will be miles apart, and the unbroken bluff correspondingly long; at other places they will be close together so that the highlands between are long and slender reminding one of piers projecting into a lake or bay to protect a harbor.

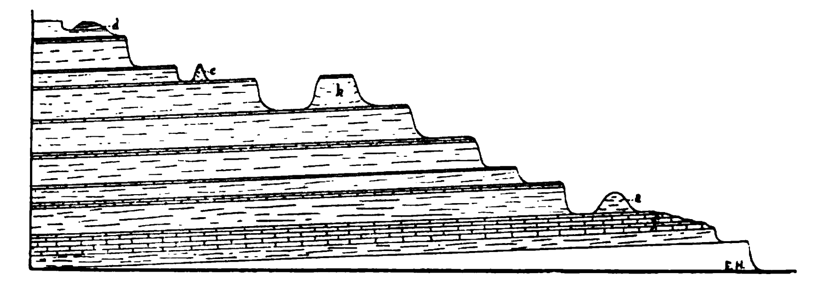
Should one explore either of the other streams mentioned he would find substantially the same conditions produced by similar causes.

But this mode of erosion is by no means confined to the areas immediately adjacent to the water courses; for the whole surface of the country is shaped under the same regulations. Figure 1 is a diagrammatic and condensed representation of the surface of eastern Kansas, together with the peculiar properties of the rocky crust of the earth at this place upon which the contours depend. It represents a series of limestone systems approximately parallel dipping gently to the west, and outcropping on a surface inclined towards the east. The intervening spaces are filled with shale or other matter which readily yields to erosion. The right hand limit of each limestone system therefore is marked by a terrace nearly as high as the distance downward to the next limestone; for, as already seen, the

friable shale will yield rapidly and almost or entirely undermine the limestone mantle above, which in time will break away as it is undermined, thus allowing the terrace to recede westward.

This is precisely similar to the conditions obtaining at Niagara Falls and many other noted places. But here in Kansas it covers the whole eastern end of the state.

Often the limestone will have been fissured back of the terrace as shown in *b* and *c*, so that a valley has been cut between it and the main land, leaving a flat topped mound standing alone. Such mounds are of most frequent occurrence, and often give a picturesqueness to the scenery which cannot be described. The frequency of such geographic names as Mound City, Mound Valley, Twin Mounds, Blue Mound, etc., tells its own story.



The walls of such mounds are always steep, sometimes almost precipitous, but their formation is easily understood, and is the same as that just given for the production of river bluffs. Thus, the diameter of the top of mound *b*, figure 1, remains constant for a long period on account of the protecting influence of the rock at the summit. But the basal diameter is rapidly growing shorter, because the shale composing the mound so readily yields. Usually the limestone at the top will break back a few feet before it has been undermined, but rarely before the hillside has become very steep. In many instances a part or all the sides of such mounds will be yielding so rapidly that vegetation cannot get a foothold upon it. But usually there is sufficient soil on top of the mound to support vegetation quite well. One noted mound on the west side of the Verdigris river near Independence, locally called Table Mound, contains nearly 1500 acres, the whole of which is utilized for an immense farm. Its summit is a level plane, as its name implies, while its walls are so steep no fencing is required excepting where roadways lead up the incline. The country from La Cygne almost to Fort Scott is particularly noted for isolated mounds and broad table lands; while across to the southwest in Labette and Montgomery counties the same conditions are repeated.

It is not unusual to observe small but high mounds which have been worn to a point, as seen in *c*, figure 1. In such cases the cap rock is still present, or has only recently been removed. For if long unprotected the sharp apex readily yields, producing a lower and rounder form, as at *a*, of the same figure. Again, the limestone covering itself yields to the solvent power of rain water. Many broad mounds and bluffs are known on which the last remnants of the limestone may be found, or possibly a mound with no limestone covering, the outlines of which have not been greatly altered by erosion because the protection was so recently removed. A good example of the former is the first mound to the south of Cherryvale, shown in the drawings for the Cherryvale-Lawrence section. An excellent example of the latter is a mound south of Lawrence, about a mile south of the Wakarusa.

Limestone is the most common protective mantle in eastern Kansas, but in some parts of the state sandstone strata act similarly, and produce a topography akin to that observed in limestone districts. This is particularly true in Cherokee county. In places the Cherokee shales between the lead-bearing limestone and the Oswego limestones grade into well formed sandstone beds, as is well illustrated to the east of Columbus. Here a system of sandstone in almost horizontal position overlies a heavy bed of friable shale in which at different places a twelve to sixteen inch bed of coal occurs. The country is worn into valleys, such as Shawnee creek and Brush creek valleys, resembling in general features the valleys of the larger streams in the state. At different places individual mounds are cut off from the main lands as already described. Southeast of Columbus a few miles one such mound stands out boldly in the surrounding valley, and can be seen for miles. It has the form of a truncated cone, is half a mile across its almost circular top, and is capped with a stratum of sandstone, below which is a thin bed of coal and a great bed of shale. This is locally called Bald Mound in distinction to similar hills near by covered with timber, and hence called Timbered Hills.

Five miles east of Baxter Springs another similar mound exists, and is probably capped with the same stratum of sandstone found at Bald Mound. Across the state line east, in the state of Missouri, but still in the same geological formation, other similar mounds exist.

It is often observed that the horizontal distance between two contiguous terraces is so great that one almost loses sight of their relation. Figure 1, to correctly represent the true condition, should be elongated horizontally several times its present dimensions. In places where the terraces are so far apart the westward dipping of the strata produces a surface inclined westward locally. This is well illustrated by the plane between Olathe and Lawrence. Olathe is

near the eastern limit of the Ottawa limestone, which is geologically about 200 feet below the Oread limestone at Lawrence, yet the elevation of Olathe is about the same as Mt. Oread, while the low grounds in the city of Lawrence are nearly 200 feet below. In other words, there is a quite gradual and even decline in the surface westward from Olathe to the foot of the hill at Lawrence.

The variation in the relative thickness of the limestones and shales causes variations in the relative heights of the terraces. If a limestone system is unusually thick, as the Iola, its upper surface gradually wears away producing a gentle inclination as from Iola to the river near Chanute, and illustrated at *f*, fig. 1. Should such a condition be found with a thin bed of shale below it the terrace features might not be noticed, and such is sometimes the case.

Again, should the under beds be quite siliceous, as the Robinett sandstone, or the Fort Scott flags, their resistance to decay may be so nearly the same as the limestone above that a gradual slope will result instead of a terraced condition. Such occurrences are by no means rare. In this way Kansas is given a great diversity of physiographic features. Yet we must admit that the prevailing and characteristic topography of eastern Kansas is the terraced topography, a condition which seems dependent principally upon the more or less regular recurrence of alternating heavy beds of soft shales with light beds of harder limestones and sandstones.

Farther to the east in the Mississippian areas limestone greatly predominates. There is therefore a lack of the alternation of harder and softer parts, or the softer beds are not relatively so heavy. The surface is much less markedly terraced, but in its place we see the more gentle undulations, or the rounded hills, rather than flat mounds. Even the novice can readily determine the boundary between the Coal Measures and the Mississippian areas by means of their topography.*

To the west of the Carbo-Permian areas the terrace features disappear, because here the whole material is soft. The Dakota sandstone and sand hills just west of Abilene cause the valley of the Kansas river to contract and the bluffs to disappear. They are partially regained farther west towards Salina, for here the harder and softer parts again alternate to a considerable extent. But the magnificent bluffs and deep broad valleys characteristic of the Kansas river and tributaries from Junction City to Kansas City are nowhere again equalled. Farther south towards Lyons, Hutchinson and

*It must not be understood that the Mississippian areas have none of the terrace features, for they have. But with that function they are the exception, while in the Coal Measures they are the rule, and hence give character to the topography.

Harper there is a broad expanse of prairie almost void of undulation. And although the material is soft like soil for 300 feet or more, as shown in mining for salt, and lies at an average elevation of 300 or 400 feet above the terrace to the east, yet the streams here scarcely cut a channel, and in no instance are well defined bluffs produced. But if we go still farther west to the gypsum hills west of Medicine Lodge, where beds of gypsum alternate with much thicker deposits of a soft soil, the terraces at once appear, the streams flow between well defined bluffs, and a topography recalling that of eastern Kansas greets the eye.

So far as has yet been determined eastern Kansas does not possess a composite topography. The broad valleys of her streams are particularly even and straight, although within these limits the channels meander from bluff to bluff as though they had long ago almost reached their base level. This is particularly noticeable of the Kansas river. The topographic sheets issued by the U. S. Geological Survey fortunately cover nearly all the territory occupied by the principal streams of the state. A careful examination of these shows that the bluff lines of the Kansas river are particularly even and free from the sinuous meanderings which sometime characterize valleys with composite topographies. But the stream within the bluffs, as is also plainly shown by the charts, meanders as gently perhaps as any stream in the state. An intimate acquaintance with portions of the valley makes it possible to state that the number of old river channels is unusually great. Some of these are now filled with water and constitute "lakes" and bayous, but the great majority of them are entirely dry and are included in the cultivated fields, so that their banks are becoming less and less distinctly marked.

The stream with the most sinuous bluff lines in the eastern part of the state is the Cottonwood river, a tributary to the Neosho river. The upper portion of the Neosho is also much more irregular than the lower. The Osage river perhaps would rank next in degree of sinuosity, while the Big Blue and the Arkansas are remarkable for the almost perectly even character of their bluff lines.

Since the character of the surfaces produced by erosion has come to be looked upon by geologists as of so great importance, indicating as claimed by some almost the whole history of oscillations of levels since the territory in question became dry land, the topography of eastern Kansas assumes a new interest. The recent discussions* regarding the origin of river channels in Missouri and adjacent states, especially the Osage river channel, increases this interest. It has seemed to the writer that possibly the peculiar method of widening

* Davis and Winslow. *Science*. April 28, 1893, July 21, 1893, and November 17, 1893.

river valleys, and of producing the terraces, mounds, and broad valleys unoccupied by streams, so common in Kansas, has not been given as much attention as its importance merits. The foregoing observations and discusssions are offered as preliminary, and will be elaborated as our work progresses.

The Surface Gravels of Eastern Kansas.

ERASMUS HAWORTH.

Perhaps no county in the eastern part of the state is entirely free from surface deposits of gravel which are radically different in character from those further north belonging to the glacial deposits, and from the various Cretacious and younger gravels found in different parts of western Kansas. The glacial gravels are found in the northeastern counties but are unknown over the greater part of the state. The gravels under discussion are composed almost entirely of flint, or chert, and are often fossiliferous. They vary in size, ranging from the size of a pea to 5 or 6 inches in diameter. Their shape is rounded, but often decidedly angular, and occasionally they have sharp, cutting edges. In color they range from the light chalcedonic varieties through different shades of yellow and red to dark, as river gravels usually do when stained with iron which is in various stages of oxydation. The light buff color greatly predominates.

They are found in beds of various dimensions, and in different positions with reference to the surface. Sometimes they form only a little sprinkling on the surface; sometimes they form heavy beds from two to three feet thick at or near the surface, and at other times they are buried from 10 to 20 feet beneath a surface soil. Their position is as varied as the surface of the country where they occur. They are found in the creek and river beds, along the banks of the streams, underlying the rich soils of the valleys, on the uplands and divides, and finally on top of the highest hills in the country.

Geographically they extend from north to south, from east to west, not over all the surface, but so extensively that one may not be at all surprised to find them at any particular place. They are found in great abundance at the northern edge of Ottawa, and almost all along the A., T. & S. F. R. R. from that point to beyond Independence. They are abundant on both sides the Neosho river from its source to its point of leaving the state, and are much more abundant along the Cottonwood river. The court-house at Cottonwood Falls stands on a hill covered with gravel to the depth of 10 feet or more. The work

during the past summer was not carried into the famous "Flint Hills," but a hasty examination made in crossing and recrossing this place by train led the writer to believe as others have stated that the "Flint Hills" have a common origin with the lesser gravel beds. Cursory examinations made from time to time during the past fifteen years indicate that similar gravel deposits are found to the south in the Indian Territory and to the east in Missouri, occupying indiscriminately the surfaces of Coal Measures and Mississippian formations. The character of the gravel is largely the same over all of the areas mentioned, and the modes of occurrence cannot be discriminated.

Such interesting formations as these gravels constitute have naturally attracted the attention of different geologists at various times. One result is that quite a literature has accumulated on the subject in which one can find many different views on the origin of the gravel and mode of formation of the beds. Without attempting to give an exhaustive review of such literature, a few references to various articles on the subject may be of interest in this connection. In 1874 Prof. G. C. Broadhead, in describing the surface deposits of Jasper county, Missouri, wrote as follows*: "The material overlying "the solid rocks may be referred to local agencies. Solid beds of "rock often appear on high ground, and can always be reached "within a few feet of the surface. The soil and subsoil, both com-"bined, are not often over two feet deep, with downward successions "of red clay and gravel for from 4 to 8 feet, to solid rock. The "gravel is even sometimes at the surface, and often within a foot "depth. A similar succession of loose material is also commonly "found at the lead mines. The banks of the streams, also, are sim-"ilar, of which Center creek exhibits:

"No. 1. 1½ feet dark soil.
"No. 2. 2 feet red clay.
"No. 3. 3 feet gravel bed to the water in creek.

"On the prairie, two miles to the southwest of Carthage, excava-"tions show water-worn chert pebbles at the surface. At the old "mines in Sec. 33, four miles southeast of Carthage, similar pebbles "were observed. These were found 60 to 70 feet above Spring river, or "Center creek; so it is quite evident that no recent agency could have "deposited them there. They must therefore belong to the Drift, "about its southern limit, but borne by currents from some place "near by."

In speaking of the surface deposits in Vernon county he writes:*

"Undoubtedly this county has been subjected to glacial agency "at some former period of time. Its results may be seen in the isolated

*Mo. G. Rep., 1873-4, p. 79.

"mounds and deep valleys between. The amount of erosion must "have been of great force and of long continuance, if we view the "mounds and long stretches of distance from one to the other. * * "* * * No drift pebbles were seen on high ground, but some "wells expose rounded gravel and sand. Near Nevada, I heard of "a gravel bed containing logs, etc., in a well 16 feet below the "surface."

Similarly when describing Bates county Prof. Broadhead says:† "That this county has been at some former time subject to extreme "denudations is evident from the isolated mounds often seen. "Their summits are probably of the same elevation as the higher "ridges in the eastern part of the county. There has been a scour-"ing from north to south, leaving isolated mounds protected from "destruction by cappings of limestone. * * * * * The force "of the glacial action which has caused this has been such as to bear "away all drift pebbles from the surface excepting when on the higher "grounds. On the mounds east of Pleasant Gap are often seen "quantities of rounded gravel, mostly siliceous. The banks of Camp "creek have exposed at one place a bed of similar gravel with sand. "* * * * * At Burnett's ferry the banks of the Osage show:

"No. 1. Soil.

"No. 2. 12 feet brown sandy clay.

"No. 3. 10 feet blue clay.

"No. 4. Bed of rounded siliceous gravel."

Later Prof. Broadhead referred to the surface gravels of Kansas in different articles published in the Kansas City *Review*,† in which he gives a good description of their geographic positions, emphasizing the fact that they so often occur on the highest hill tops. He refers the age of the gravel to the Coal Measures, but that of the gravel beds to the "Later Glacial." It will thus be seen that Prof. Broadhead, whose observations have been very extensive, attributes the origin of the *gravel* to the local formations for both the Missouri deposits, and the origin of the *beds* or *layers* to the later glacial action. In this respect his views are similar to those of St. John, as is shown by the following quotations:‡ "To the latter [the modified drift] belong the "ordinary superficial deposits spread over the southeastern portion of "the state, among which no vestige of true glacial erratics * * * "* * have been detected, whose accumulation was due to the "denudation and disintegration of the limestone, sandstone and "shaly deposits occurring in the region where they exclusively con-"stitute the evidences of the action of powerful denuding agencies,

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*_Ib._ p. 121. †_Ib._ p. 156.

† *Kansas City Review of Science and Industry*, vol. iii. p. 460, and vol. viii, p. 453.

‡ Rep. Kan. St. Board Agr., 1881-82, p. 598.

"which may, with much reason, be identified with the Champlain "epoch."

In a later publication he writes:* "In regard to the chert gravel "from the Neosho valley near Burlington, Kansas, it is per- "fectly safe to say it comes from the chert beds overlying the heavy "building limestone series, well up in the Upper Coal Measure series; "* * * * * It may not be strictly a 'glacial' gravel, although "these particular deposits might well have in part been the result of "glacial agencies; but they are to be regarded as of local origin, as "we can distinctly trace them to their native ledges only a few miles "to the west or northwest of their present position in the gravel "deposits. * * * *." From fossils contained in the gravel, St. John decides they are identical in age with the Coal Measure rocks, many of which contain large amounts of chert.

Prof. Mudge, who was so familiar with Kansas geology, visited the Burlington gravel beds in 1871 and expressed the opinion, according to Parker,† that they were the result of "modified drift," whatever that may mean.

The gravel beds in the vicinity of Burlington years ago attracted considerable attention, and an effort was made to introduce the gravels for paving streets, walks, etc. In this connection Prof. J. D. Parker published a number of articles giving descriptions of the character and extent of the deposits. He also sent samples to different scientists and civil engineers, thereby hoping to gain information regarding their age, mode of formation, economic importance, etc. Prof. C. F. Chandler, of the Columbia College School of Mines, wrote that the character of the gravels was such that they would do excellently for macadamizing. Different physicians recommended their use from sanitary standpoints, their color being preferable to that of limestone which reflects the sunlight to so great an extent that it is objectionable for street paving purposes. City engineers advised their use for street paving on account of their great durability, so that it looked for a time as though an industry of considerable proportions might spring into existence. Prof. C. A. Schaeffer, of Cornell University, now president of Iowa State University, to whom samples were sent, reported the character of the pebbles, as already given, and added that he had succeeded in identifying included fossils as belonging to the two genera *Fenestella* and *Trematopora*. From this fact he decided that the gravel belonged to the Silurian period. But as these genera extend from the Silurian to the Coal Measures their

*Private letter to Prof. J. D. Parker, published in *Kansas City Review*, Vol. 8, p. 386, 1884.
†Ib., p. 386.

existence by no means is at variance with the views of others who refer the gravel to the Coal Measures.

In 1884 Judge E. P. West read a paper before the Kansas Academy of Science,* entitled: "The Last Submergence and Emergence of Southeastern Kansas from the Carboniferous Seas, or those Effecting the Carboniferous Formations in Kansas," in which he attributed the present topography of the eastern part of the State to a relatively modern submergence below the sea level, during which time, he thought, the valleys were eroded, the terraces formed, and the gravel beds produced. In this paper he was unable to fix a date for either the beginning or the ending of the submergence, but subsequently† he decided that the period was the same as that portion of the glacial period during which the Loess was deposited along the Missouri river, and that the submergence involved nearly all of Kansas and parts of Nebraska, Iowa, Missouri, Illinois, Arkansas, Louisiana, Indian Territory and Texas. He admits, however, that no trace of marine deposits has been found over this vast territory, and seems to rely wholly upon the extent of erosion, and the gravel and other surface deposits for the evidence of such a wide spread submergence. How well this accords with the generally accepted views of erosion the reader can judge.

It will be seen from the foregoing that the prevailing opinion has been that the gravels themselves originated in the Coal Measure limestone, and that the accumulation of the beds was in some way connected with the glacial period, probably with the heavy floods produced by melting ice.

Our labors the past summer have demonstrated a few points which may have an important bearing on the subject. First, we have become convinced that chert has such a wide spread distribution in the different limestone systems of the state that transportation has been necessary in few instances, possibly in none. Could the limestone as now seen be dissolved in a day the amount of chert left behind would be surprisingly great. Scarcely a single system has been studied carefully which did not contain surprisingly large amounts of it. The lead bearing limestone of Galena has sufficient chert to produce beds of gravel a fourth as thick as the limestone system. The Erie limestone is particularly filled with chert, as may readily be seen wherever it is exposed. Along the west bank of the Neosho river for a few miles below Austin is a splendid place to make such observations. Chert nodules of many shapes and sizes are

*Published in *Kansas City Review*, Vol. 8, p. 477, and also in Trans. Kan. Acad. Sci., Vol. IX. p. 106.

†*Kansas City Review*. Vol. 8, p. 566.

here to be seen in great abundance. They are uniformly filled with seams which in position are entirely independent of the fissures in the enclosing limestone. When they weather out of the limestone they fall into many fragments corresponding in size very well with the gravel near by. Farther to the west other beds of limestone are particularly noted for the heavy amount of chert they carry. Number 15, in the Neosho river section, lying on the Neosho between Council Grove and Parkerville, and along the Cottonwood river between Strong City and Elmdale is one of these. Quite possibly it is the equivalent of the Fort Riley limestone which is so rich in chert.

In the second place it has been observed that the gravel usually is most abundant in the vicinity of a limestone system rich in chert, or in places over which such limestone probably has extended. The gravels about Oswego occupy space undoubtedly covered at one time by the Erie limestone; those so abundant about Cottonwood Falls lie under the earlier extension of system number 15 which carries so much chert. On the other hand the large area occupied by the Cherokee shales has but few places where the chert gravel can be found.

In the third place we found that many of the rounded surfaces possessed by the gravel are the original curved forms the cherts possessed while in their limestone hosts. This is particularly noticeable at Cottonwood Falls. Countless numbers of these have unmistakably such rounded forms. Some were found with traces of the limestone still adhering, others with the curved surfaces still possessing the rough character the chert surfaces have while in the limestone, and which in no particular resemble water-worn surfaces. The angular parts of the chert often have been worn little more than one would expect to observe on chert masses which had been subject to the weathering agents for long geological periods with such slight movements as might well be attributed to local causes.

It seems very probable, therefore, that in most instances the surface gravels of eastern Kansas have been derived from the native limestone systems, and that they are the direct results of the weathering of those limestones which, when dissolved and carried away by solvents, have left behind the less soluble chert. The chert boulders of such varied sizes and shapes fell into fragments on account of the numerous fissures everywhere prevalent, and the gravel was the result. As terrain after terrain yielded to the slow but sure processes of disintegration and destruction the insoluble gravels formed residual products which gradually settled to the lowest level possible, which may have been the summit of a hill, or the bed of a river, or any intermediate position. Here and there the rolling

down the hill side, the being moved by water in times of floods, the abrasive effects of moving soil and sand produced by wind or water, rounded the edges and blunted the sharp angles, in some places more than in others. Similarly the gravel has accumulated, now in broad, even layers, then in winrows formed by irregular surfaces and unequal amounts of the chert in the limestone. If there ever was a period during which Kansas was flooded by water from the melting glaciers such waters of course would assist in working over and arranging the gravel into beds. But the intimate association of individuals of such different sizes, the mixing of the large and small, shows that the sorting power of water has acted but slightly if at all.

This view is believed to be in harmony with the generally accepted views of leading geologists regarding the origin of many other formations of similar character. Surface gravels are present in many different parts of the world. They cover the highest hill tops of our great mountain systems, and fill the deepest valleys. Altitude seems to have no effect upon them. They were perplexing in the extreme until geologists began to look upon them as being only residual products left behind when the more perishable materials passed away.

A Geological Reconnoissance in Southwest Kansas and No Man's Land.

BY E. C. CASE.

That portion of Kansas lying south of and bounded by the Arkansas river, together with the western arm of the Indian Territory known as No Man's Land, or Beaver county, is comparatively an unknown region to the geologist. St. John in Vol. IX of the Reports of the State Board of Agriculture gave a somewhat general account of the region, but failed to recognize, with certainty, as Triassic the friable red sandstone that covers a great part of the region. Later, Hay published in the U. S. Geologic Bulletin of 1890 a more detailed account of the eastern portion of this region, giving the Triassic due rceognition. During the past summer, under the direction of the Department of Palæontology, the writer made a trip through this region, following especially in Seward, Clark and Meade counties, and in the adjoining portion of the Territory, the western limit of the red Triassic beds.

There is little of interest to the casual observer in this region. The succession of prairie flats and shallow, sand-choked water courses, is monotonous in the extreme, but to the geologist it is replete with interest. The object of the trip was the examination of a terrane visited by Cragin in 1890, and by him referred to the Loup Fork Tertiary (*American Geologist*, July, 1891, p. 29). The deposit was reported to be rich in impressions of Tertiary leaves. A further object was to make a general reconnoissance of the country preparatory to more extended work by the University. The southwestern counties of Kansas—Stanton, Morton, Grant and Stevens, are covered with the Tertiary sand and the characteristic coarsely cemented sandstone, or "mortar-rock," with the exception of bluffs of Dakotah sandstone on the head-waters of the Cimarron, as stated by St. John. The same formation extends over Haskell, Seward and Meade counties, with the exception of a deposit of Cretaceous extending at least as far south as Meade Center, or to the middle line of the county. In Clark, Comanche, Barber and Harper counties, and northward into Kingman and Reno counties, the Triassic has been located, edged on the north by the Cheyenne beds of Cragin.

It was in these counties, and in Barber county, that Hay did most of his work, but his descriptions apply in nearly all particulars through the whole formation. The gypsum, alone, becomes less apparent as we go west and south.

Leaving Liberal, a little town on the Rock Island railroad, in Seward county, and striking directly south to the North Fork of the Canadian river, or Beaver creek, as it is more commonly called, the whole prairie is monotonously level, there being probably not a variation of fifty feet in altitude in the whole twenty-five miles. This flat is covered with the later Tertiary, so common over the western portion of the state. Upon the banks of the creek, the Tertiary thins out to a few feet in thicknes, and the red sandstones and clays of the Triassic peep out from the gullies and rain-washed hill-sides. The valley of the creek is about a mile wide, filled on the north side with shifting sand-hills made up from the decomposed Tertiary sandstone and the drifting sand from the flats on the south, which extend far into Texas. The sand, carried by the prevailing winds in a direction from south of west to east of north, has gradually crossed this valley, and piled against and upon the bluffs on the north side, leaving behind a level plain, and an altered river-course. The sand-hills slope gently on the southwest side, and are sharply excavated on the northeast, in some cases covered with stunted sage brush and cottonwoods, but more frequently perfectly bare.

The Triassic shows a bewildering number of dips and faults, too numerous and complicated to more than find mention in any but the most detailed description. The hard Tertiary grit lies unconformably upon every layer of the Triassic, from the highest to the lowest. It has been largely carried away by erosion and only appears on small, isolated areas, but these show the effects of similar disturbances. The red sandstone of the Trias outcrops in the same peculiarly irregular manner, bluffs from thirty to fifty feet high disappearing within a hundred feet and replaced by Tertiary grit or sandy shales of the lower Triassic. The whole region has evidently been subjected to extensive foldings, both before and since the deposition of the Tertiary. In Seward and Meade counties, and the region of the Territory directly south, Beaver creek may be taken as the southern boundary of the Tertiary grit, in a general way, although it appears on the hill-tops further south. In the eastern part of Beaver county, and in Clark and Comanche counties, the boundary of the outcrop moves north nearly to their northern boundaries. As the line of the Tertiary retreats, the "red dirt" of the Trias appears in larger and larger beds, worn and eroded, till it presents an appearance in everything but color strikingly like the chalk beds along the Smoky Hill

river. The beds are cross-lined in every direction by thin layers of impure gypsum, with occasionally one eight or ten feet in thickness, occurring as low down as the middle af the formation. The upper layers in these beds have in some cases been hardened by infiltration of silica from the Tertiary, and stand out in overhanging shelves from the softer limestone below, very much as described and figured by Hay in his article on this formation further east.

In one place, about half way between Beaver City and Alpine, there is a bluff, some twelve feet high, composed of coarse conglomerate, the layers of which show the irregular stratification of beach formations. Other less well marked instances of this beach stratification are not infrequently met with.

The extreme irregularity of the strata renders any very accurate account of the successive layers a matter of difficulty, but, in general, there is first the Tertiary grit, below, a layer of laminated flint overlying a thick bed of impure limestone five or six feet thick, and filled with shells of *Planorbis*. Under this, more flint, containing shells and impressions of reed-like leaves. Lowermost of all, is the chalk having the leaf impressions. There are, besides, several layers of sandstone, all so thin and irregular in their outcroppings as to make their true relations doubtful. The Trias has first the thick red sandstone interlined with gypsum in its upper portions; then several layers of sandy shale, alternating with sands of a yellow or black color and friable red sandstone. These black sand-beds have been the subject of some little local excitement, as possibly gold-bearing.

The chalk appears in limited outcrops for about thirty miles along both sides of the Beaver, at a distance of three or four miles from the immediate river valley. The chalk is fairly homogeneous in composition, some portions being a little more coarse than others, probably due to a variable percentage of silica. Some of the upper layers have a conchoidal fracture. All the outcrops are capped with flint in layers and nodules, the nodules are also interspersed throughout the chalk. The flint frequently contains impressions of leaves, but, owing to its peculiar fracture, it is difficult to obtain good specimens from it. The largest bed of chalk though not the richest in specimens, is that on the south bank of the Beaver, about four miles up a small tributary, called "Gypsum Creek." It dips abruptly to the west and north, and is thickly covered with flint and Tertiary *debris*. Near the upper surface of the chalk are two seams, each about six inches thick, filled with shells and impressions of reed-like leaves, evidently aquatic. The matrix is a sandy, carbonaceous material, mixed with flint nodules. Cragin found in these layers a tarsal bone, which he referred to the *Camelidæ*. The remainder of the chalk is

massive, homogeneous, and of a very fine texture. It is easily worked by sawing, and is used as a building material for milk houses and well curbs, though not very durable. It is of a clear, gray color when damp, but bleaches out to a brilliant white on drying. The chalk is laminated to an extent that causes it to split easily, especially through the plane of the leaf impressions, which aids greatly in their collection. In the upper layers the impressions are colored by iron and, according to Cragin, by the residual carbonized material of the leaves themselves. The leaves obtained are mostly from the genera *Salix*, *Sapindus*, *Ficus*, *Platinoides*, and *Populus*.

Besides the leaves already known from this formation the writer was so fortunate as to discover the remains of several small fish and a shrimp-like crustacean.

Just south of this large bed, over a slight rise is a thick out-cropping of soft sandstone overlying the chalk, capped with flint and having seams of carbonaceous material similar to that in the chalk. The thin layers contain fragments of mammalian bone colored a deep chocolate but in such a fragmentary condition as to make classification impossible. In the more solid parts were found portions of the carapace of a turtle, what appeared to be the head of the humerus and portions of the scapula and ribs of an animal the size of a horse, also three tarsal and metatarsal bones from the foot of a large carnivorous animal.

Following the line of the Tertiary northward we find in the neighborhood of Ashland and Vesta, in Clark county, that the Cheyenne or Comanche Cretaceous separates very indistinctly the Tertiary from the Triassic. It is represented by a yellow sandstone growing thicker towards the east and filled in places with shells. Above this is a layer of the clayey soapstone, so called, also thickening towards the east. This increases in thickness from a few feet at Vesta to nearly thirty, a mile east. The outcrop of the Cretaceous is nowhere more than a quarter of a mile wide and is continually obliterated both by the Triassic and the Tertiary. The Tertiary is of the usual soft, massive sandstone, whitish or pinkish in color and containing in widely separated spots fragments of mammalian bones. There are two distinct layers of the mortar rock, each at least twenty feet thick. About sixteen miles south of Englewood, Clark county, there is a sunken bed, a space is enclosed by the precipitous walls of the Tertiary sandstone at least fifty feet in height, broken by gullies and draws. The space enclosed includes at least six hundred acres, and is very level. Curiously placed with regard to this "Big Basin," though possibly without regard to it, is a large spring, about half a mile distant, called "St. Jacob's Well," a well of about fifty feet in

diameter and of unknown depth, having been sounded for over a hundred and fifty feet and no bottom found. It has an outlet and never varies in the height of the water. There is a slight current across the surface of the water, which is pure and sweet, having no taste of salt as is common in the waters farther south.

Traces of a Glacier at Kansas City, Mo.

E. C. CASE.

During the last summer it was the fortune of the writer to discover on the bluffs of the Missouri River in Clay county, Mo., just opposite Kansas City, the traces of a glacier as shown in the scratching and planing of a surface of limestone which outcrops about half way up the bluff some 80 or 100 feet above the present river bed. The striae are rather light, seldom over half an inch in depth, and would seem to indicate that the boulders that acted as graving tools had been reduced by trituration or other processes to a small size. This is further borne out by the fact that there are no boulders of any size to be found in the neighborhood. The striae are continuous, or practically so, being straight, clean-cut scratches, and showing no termination in the small space exposed in the workings of the quarry. The continuous character of the scratches with the absence of any gouges or other intermittent markings would indicate that it was an ice field, or glacier, rather than icebergs or floes. (Report Director U. S. Geol. Survey 1885-6, p. 29).

The striae are in two sets that display among themselves a remarkable degree of parallelism. The greatest number of lines run in a direction from one to two degrees west of north. The second series corresponds almost identically with a northwest to southeast line. These markings occur on a surface of limestone belonging to the topmost layer of the region and covered directly by the clay. The extent of the abrasion it is therefore impossible to estimate, but it was probably slight as the glaciation is only to be noticed in a very limited area at the highest portion of the outcrop in the bluff. The extreme limit of glaciation that could be traced did not exceed a quarter of a mile, but was very distinct in that distance.

The dip of the strata, as is the case generally in this region, is toward the northwest and thus opposed to the probable advance of the glacier, and would account for the scratchings which under these conditions might be produced by a very small glacier or one near the limit of its southward movement. (Chamberlain, Report Director U. S. Geol. Survey 1885-6, p. 160.)

Previous to this time there have been no glacial markings noted in Missouri and but one region, in Nemaha county, in Kansas (L. C.

Wooster, *American Geol.*) The entire region is covered, however, with drift material at least as far south as Ottawa in Kansas and the Osage river in Missouri, and there is little doubt that a careful survey of the belt bounded on the north by the state lines of Kansas and Missouri and on the south by a line indicated by the Kansas and Missouri rivers would add greatly to our knowlege of the action of the glaciers of the Great Ice Age in the southern limit of their range.

New Genera and Species of Dolichopodidæ.

BY J. M. ALDRICH.

Dactylomyia.

New genus (Gr. *daktulos*, finger, toe; *muia*, fly).

Face narrow, slightly wider above and below, a transverse suture sets off the lower third from the upper portion. The antennæ are inserted high up, making the front exceedingly short. Antennæ small, very short, the three joints crowded together; third joint oval with apical or subapical arista; first joint bare above. Occiput convex, the cilia of the inferior orbit becoming scattered and irregular near the mouth. Acrostichal bristles in two rows; a sub-quadrate, slightly impressed spot before the scutellum, the latter with but two bristles. Abdomen short, and strongly arched downward, only partially metallic in color. Hypopygium large but short, bent forward under the venter; it has no lamellæ or projecting parts but is a globose structure with a wide opening anteriorly. Fore coxæ very long. All the legs exceedingly long and slender, the tibiæ longer than the femora, and the tarsi longer than the tibiæ. Hind metatarsi not shortened. Wings slender, not narrowed basally, the cross-vein nearly in the center, oblique, distant twice its length from the margin (on the fifth vein); the third and fourth veins gradually converge beyond this point and end near together, the fourth decidedly before the apex; just before the end they are nearly parallel.

This genus has the longest legs of any in the family, that I have ever seen. The hind leg is a trifle over twice the length of the whole body, and the others scarcely less. The wing venation reminds of Medeterus, and the habits are the same, both being found on the bark of trees; but the legs, face, hypopygium, etc., are different.

Dactylomyia gracilipes, n. sp.

Male. Face long and narrow, slightly wider above and below, silvery white pollinose. Palpi and proboscis yellow. Front covered with grey pollen. Antennæ yellow, tip of third joint slightly brownish; arista subapical or very nearly apical. Cilia of inferior orbit white. Dorsum of thorax green with thick brownish-grey dust; the posterior impressed area bluish. Pleuræ green with white dust. Halteres and cilia of tegulæ pale yellow. Posterior margin of the pleuræ pale yellow. Abdomen shining blue-green, the anterior edges

of the segments, particularly the second, more or less yellow, usually showing this color only along the sides. Venter yellow. Sixth segment and hypopygium wholly yellow. Coxæ yellow, the anterior ones, very long, with a thin row of pale hairs in front; the intermediate ones brownish at the extreme base; posterior ones with a single dark bristle on the outer side. Legs and feet wholly yellow; the front tibiæ slightly longer than their femora, the first two joints of the fore tarsi are elongate and slender, together longer than the tibia; the remaining three joints very short, subequal. Middle and hind legs and feet simple, but exceedingly slender. Wings hyaline with yellow veins, sixth vein almost obsolete.

Female. Face scarcely wider; antennæ a very little shorter; fore feet fully as long as in the male, but the joints successively shorter, as usual. In both sexes the middle metatarsus is longer than the tibia.

Length, 2.5-2.8 mm.; of wing, 3 mm.

Numerous males and females, Brookings, South Dakota. Common in July on the trunks of trees. I collected it on willow, cottonwood, and box elder. A single male from Florida, sent me by C. W. Johnson, does not seem to be specifially distinct.

Metapelastoneurus.

New genus.

Male. Face wide, convex below; antennæ short, the third joint rounded, with a dorsal, plumose arista; fourth vein of the wing bent forward near its tip, ending but a little distance behind the third; hypopygium exserted, about as long as the fifth abdominal segment, bent forward under the venter; at its tip prolonged into four filaments which reach the posterior coxæ.

The only essential difference between this genus and Pelastoneurus is in the structure of the hypopygium. The basal segment of the organ in a typical Pelastoneurus (*vagans*) is long and slender, and the central portion is also somewhat slender. Besides the small hook-like processes at the tip,—the true grasping organs—the hypopygium also bears two narrow fringed lamellæ, arising from the tip at the edge which would be called dorsal were the organ extended behind the abdomen. These lamellæ are homologous with those which are so conspicuous in the genus Dolichopus.

In Metapelastoneurus, the hypopygium differs from that just described in being very short and compact in structure. The basal segment is embeded in the abdomen, instead of forming a peduncle. The central portion is thicker and a third shorter than that just described. The lamellæ, however, are most modified of all the parts,

each being divided close to the base into two long filaments. The dorsal (as above) one of these is somewhat more heavily fringed and a trifle longer than the other, and bears near the base on the ventral side a slight protuberance, surmounted by a tuft of hairs.

Metapelastoneurus Kansensis, n. sp.

Male. Palpi yellow, face silvery white, front violet bronze, cilia of inferior orbit black. Antennæ yellow, third joint brownish at tip; arista with fine, sparse hairs. Dorsum of thorax shining green, with bronze and somewhat violet reflections; a silver spot in the ante-alar groove, below a bronze stripe. Pleuræ silvery pollinose, over a green ground-color. Cilia of tegulæ dark, halteres yellow. Abdomen shining green, the sutures bronze, and the sides somewhat white pollinose. Hypopygium blackish, the slender filaments brownish, fringed with delicate yellowish hairs, longer toward the tip. Legs yellow, plain, the middle and hind coxæ blackish except at tip; middle and hind tarsi somewhat infuscated toward the tip. Wings distinctly infuscated, venation the same as in the common *Pelastoneurus vagans* Loew.

Length, 3.5 mm.; of wing, 2.6 mm.

New Males, Western Kansas, (University of Kansas collection).

TABLE OF SPECIES OF SYMPYCNUS.

1. Fourth longitudinal vein ending before the tip of the wing,.................. .... *tertianus*, Loew.
   Fourth longitudinal vein ending at the tip................ 2
2. Antennae entirely black,.................... *frontalis*, Loew.
   Antennae pale at base.............................. 3
3. Thorax with longitudinal lines................ *lineatus*, Loew.
   Thorax without longitudinal lines..................... 4
4. Arista of male with a small lamella at tip....... *nodatus*, Loew.
5. Arista of male plain..................... *occidentalis*, n. sp.

Sympycnus occidentalis, n. sp.

MALE. Head rounded, the eyes contiguous or apparently so on the face, palpi yellow, minute; antennae inserted very high up (as in all the genus), making the face long and the front short. The front is slightly excavated, covered with grey pollen. First joint of antenna long and slender, brownish-yellow; second joint brown, short, extending in a roundish projection along the inner side of the following joint; third joint as long as the first, oblique in shape, the upper and lower edges parallel, and the tip almost squarely truncate; on its inner side the lobe of the second joint reaches nearly to the middle; the

arista arises from about the middle of the upper edge, and is scarcely longer than the three joints taken together. Cilia of the inferior orbit pale. Thorax short and rounded, brownish black, not shining, with stout black bristles above, cilia of the tegular pale. Dorsum and pleurae grey pollinose. Halteres yellow. Abdomen slender, clavate, the first segment brownish, the second yellow, the third reddish brown, the following ones passing into black. Hypopygium black, but little protruding, the sides of the first abdominal segment have a few widely divergent yellow hairs. Coxae yellow, the middle ones brown at base, the leaf-like upper extension of the hind ones (metathoracic epimera, Loew, Monogr. Dolich., p. 96) also yellow. Legs and feet yellow, the latter only a little darker toward the tip (hind feet missing), the fore tarsi are longer than their tibiae; the first joint comprises nearly half the length, and has on the lower surface near the base two or three noticeable hairs; the second joint one-third as long, thickened; the following joints slender, short, of equal length. The middle tarsus is plain, slender, once and a half as long as its tibia. Hind fémora and tibiae plain. Wings yellowish, very broadly rounded at the tip, and narrowed towards the base; the third and fourth veins beyond the cross-vein are parallel, then the latter gently approaches the former, then they continue parallel to the end.

FEMALE. Face rather wide, wholly grey dusted; antennae inserted as in the male, the first joint lengthened a little less, and the third joint smaller, rounded. Abdomen wholly yellow, verging somewhat into brown. Legs plain. Wings not broadened at tip nor narrowed basally.

Length, 3-3.5 mm.; of wing, 2.5-3 mm.

Two specimens—male and female—Wyoming (University of Kansas collections.)

Additions to my Revision of Hygrocelenthus and Dolichopus,

(in the *K. U. Quarterly* for July, 1893.)

Hygrocelenthus idahoensis, n. sp.

MALE. Face moderately wide, snow-white pollinose; palpi yellow; front shining green. Antennae black, not larger than in an average Dolichopus, but the first joint with a swollen yellow protuberance on the inner side; the second joint also slightly yellow on the inner side; arista rather stout. Cilia of inferior orbit snow-white, flattened, conspicuous. Dorsum of thorax shining bluish-green, the dark stripe above the root of the wing almost wholly absent; pleurae green, with thin dust; cilia of tegulae pale, not large. Abdomen bright blue-green, with rather stout bristles along the posterior margins of the

segments; no yellow hairs on the sides. Hypopygium green at base, black distally; the lamellae are small, white, rounded, with a rather wide margin of black along the apex, where there are the usual curved bristles. Fore coxae yellow, on the outer posterior part a greenish-black stripe; on the anterior side with silvery dust and a few dark hairs along the lower part. Middle and hind coxae black, the former with yellow tips. Hind trochanters black, the middle ones with a black spot. Femora and tibiae yellow, all the tarsi infuscated from the tip of the first joint; fore tarsi simple, about as long as the tibiae; the preapical bristle of the hind femur is the last and largest of a series of bristles, beginning near the base of the femur.

Wings hyaline, the anterior part a little yellowish, and the cross-vein slightly clouded. The shape is broad, with an incision at the tip of the fifth vein. The fourth vein ends before the apex; it has a moderately strong curvature. Costa with a long, strong swelling near the tip of the first vein.

FEMALE. Face broad, greyish-white; antennae as in the male; cilia of tegulae larger than in the male, black, with a slight admixture of pale. Wings narrower, less yellow anteriorly, costa not thickened.

Length, 5.2 mm.; of wing, 4.8 mm.

About 75 specimens, both sexes.

Common at Moscow, Idaho, in September, at the edge of streams.

I have deposited a set of types in the University of Kansas collection.

In both sexes this species is distinguished from *crenatus*, O. S., by having plain, short antennae. The male differs from *afflictus*, O. S., in lacking the yellow fringes on the abdomen, while the female of the former has a rather less abrupt curve in the fourth vein, but is very much the same in other respects.

Hygroceleuthus latipes, Loew.

I found this specimen very abundant at Lake Mills, Wisconsin, in August, on the bare mud adjoining water. In some places they seemed almost to cover the surface.

Hygroceleuthus crenatus, Osten Sacken.

Abundant at Moscow, Idaho, in September, along the edge of water. The specimen of which I figured the antenna in my previous article is not far from typical, although I there referred to it as a variety.

Dolichopus tenuipes, n. sp.

MALE. Face rather narrow, yellow pollinose, below more grey; palpi yellow; front green, with yellow dust; antennae moderately

long, the first two joints yellow, the third brownish or blackish. Cilia of inferior orbit pale. Thorax green, thickly dusted with yellow, not very bright. Above the root of the wing but little brown. Pleurae blackish-green, rather thinly dusted. Cilia of the tegulae black. Abdomen green, before the incisures more coppery, on the sides white.pruinose. Hypopygium green basally the remainder black, the lamellae white, ovate, the apex with an ill defined black area, the apical bristles far less strong than in most of the species. Coxae yellow, the hind and middle ones considerably blackened at base; the anterior side of the fore coxae is thinly silvery pollinose, the dark hairs very minute except near the apex. The first joint of the fore tarsi is yellow, slender, not very long; the second joint is longer, exceedingly thin and flattened, bare above and below, the edges however with small hairs; the third joint is like the second in structure, as long as the first; fourth joint very small and short; fifth black, compressed, oval in outline, nearly as long as the third, the claws however are attached near the base, so the greater part of the length is a disc-like elongation beyond the claws. Beyond the first joint the color is dark. The total length is twice that of the tibia. Middle and hind tarsi each once and a half the length of its tibia, pale at base. Wings long and rather narrow, costa scarcely thickened, veins yellowish.

FEMALE. Face broad, greyish-yellow pollinose; third joint of antennae reddish-brown or brownish, the tarsi simple, about one and a third times as long as their respective tibiae.

Length, 5.2 mm.; of wing, 4.7 mm.

Moscow, Idaho; nineteen males and fourteen females. Common at the edge of water in September. I have deposited a set of types in the University of Kansas collection.

I have recently sent to the *American Naturalist* an account of the courtship which occurred in the two preceding species.

This Dolichopus differs from all the known species in the construction of the fore tarsi in the male; with *grandis* Ald. it shares the distinction of being the only species with the second joint of the male fore tarsi longer than the first.

Dolichopus setifer, Loew.

Four males, five females, Lake Mills, Wisconsin, August. The black spot in the tip of the wing of the male is an easy distinguishing mark of this species. Collected at edge of water,

Dolichopus ovatus, Loew.

Numerous specimens, collected with the preceding.

Dolichopus duplicatus, Aldrich.

Kansas University *Quarterly*, July, 1893, p. 18.

Nine males, five females, Moscow, Idaho, at edge of water in September. The females are not distinguishable, except by a slightly larger size, from those of *tenuipes* Ald. The male lamellae, which I could not well make out in the type, are very peculiar. The apical lobe is incised all along its outer border so as to have a sort of fringe of a dozen or more narrow divisions, upon the tips of which are delicate hairs. The strong curved bristles are entirely absent.

Dolichopus ramifer, Loew.

One male, Moscow, Idaho, September.

ERRATA: P. 153 midway, for New Males, read Two Males; p. 154 in sub-titles, for Hygrocelenthus, read Hygroceleuthus.

Descriptions of North American Trypetidæ, with Notes.

BY W. A. SNOW.

PAPER I.

(With Plates VI and VII.)

In the following pages I have preferred to consider six as the number of segments composing the abdomen of the female Trypetid, and five as composing that of the male. Loew united the first two segments and called them the first (Monograph I, p. 54), allowing five segments to the female and four to the male. However a discrepancy occurs in his description of *Trypeta palposa* (l. c., p. 74) wherein he speaks of the *fifth* segment of a male specimen. Where the ovipositor is spoken of below, the first joint alone is meant. First vein, second vein, etc., denote first longitudinal vein, second longitudinal vein, etc.

The material used in the preparation of this paper belongs to the museum of the University of Kansas. I have also had access to types of exotic forms in Dr. Williston's collection, and I wish to make a grateful acknowledgment to him for this and many other favors and suggestions.

All specimens with habitat of Connecticut are of Williston's collecting; those from California of Baron's.

Epochra canadensis Loew (Pl. VI, f. 6).

One male (Maine) in poor preservation apparently belongs here. The wing agrees with the description; the stature of the body can hardly be called "short and rather broad;" the scutellum has four bristles. Loew was in doubt whether the normal number of bristles on the scutellum was four or six. The reddish abdomen is black at the base and on the two distal segments, but this coloring has much the appearance of being the result of dessication.

Straussia longipennis Wied.

Three females from Connecticut, are Loew's variety *perfecta*. In one of them the median dorsal stripe of the thorax is not blackened

at the anterior end. Seven females from Douglas county, Kansas, May and June, also show no black on the thoracic dorsum; while in a single male, June, the black stripe-beginning is distinct. The picture of the wing of the latter specimen is like that of the females, only less distinct.

Variety *typica* of Loew is represented by numerous specimens. The female of this variety shows but a very slight infuscation at the tip of the ovipositor, while in *perfecta* the ovipositor is much more broadly blackened. Five females, Douglas county, Kansas, and two from Connecticut. In two of the former and one of the latter the picture of the wings is similar to that of the females, except that the brown which runs along the end of the fourth vein is more attenuated. The brownish spot in the second costal cell varies in size in the different individuals and is sometimes lacking in the male. All the Kansas specimens were taken in May. A male and female from Connecticut come nearest this variety, though the lateral stripes of the thorax show a little darker than the rest of the dorsum. In the male, moreover, the brown rivulets which cross respectively the anterior and posterior cross veins are confluent between the third and fourth veins.

Two females, Connecticut, differ from the preceding variety in the picture of their wings. The hyaline band running between the two cross veins, ends between the second and third veins, and does not reach the costa, resembling in this point Loew's variety *arculata*. The brown rivulet bordering the tip of the wing, joins the brown along the end of the fourth vein. Thus the brown border of the wing is uninterrupted from the triangular hyaline spot near the stigma to beyond the termination of the fourth vein. A female from California differs from the Connecticut specimens in not showing the conjunction of the two brown stripes at tip of wing; the oblique hyaline band between the cross veins ends abruptly at the second vein; the metathorax has a black picture and the abdomen is reddish brown, doubtless darkened in process of drying.

Six specimens, male and female, from California and Douglas county, Kansas (May and June), agree with variety *vittigera*, Loew. The Kansas specimens are smaller than the others, measuring but 5 mm.

Two males, Douglas county, Kansas, add, if possible, to the confusion in this group. One has comparatively slender and pointed frontal bristles, a black spot upon each basal corner of scutellum, and two blackish spots on metathorax. Dorsum of thorax without lateral black stripes. Wings, on first fourth yellowish, on remainder, deep smoky-black except a small triangular hyaline space at end of

first vein, a larger similar space on the posterior border of wing in second posterior cell, and the larger part of the third posterior cell. Accordingly the black of the submarginal, first posterior, first basal, and discal cells is entirely unrelieved. The other specimen has very strong, truncate frontal bristles, lateral stripes on thoracic dorsum, black spots at the corners of scutellum and large black spots on metanotum. The picture of the wings is a deep brown, and differs from variety *perfecta* in its darker color, and the brown rivulets being much broader and consequently to a great extent confluent. The area enclosed by the second and fifth longitudinal veins is brown except for (1) a hyaline spot reaching from the costa to the third vein and answering to the anterior end of the hyaline band which passes between the cross veins in *perfecta*, etc.; (2) a subtriangular hyaline spot in the discal cell below the small cross vein and corresponding to the posterior end of the band above alluded to; (3) a large clear scallop in the second posterior cell; and (4) a triangular spot above the end of the fourth vein. A third male specimen resembles the latter except that the brown picture of the wing is more encroached upon by the hyaline.

The material at hand, though not large, is sufficient to show the inadvisability of erecting any of the members of this group to the importance of species, though specimens may be selected which present a vivid contrast. It is even almost impossible to characterize distinct varieties. The most constant character for such differentiation lies apparently in the relative size of the frontal bristles in the males. In regard to the characters of the wing pattern there are not only gradations between seemingly distinct varieties, but even the two wings of an individual show considerable differences. Characters derived from the picture of the thorax are also very unstable.

Spilographa electa Say.

Six specimens, Douglas county, Kansas, Connecticut, Georgia (Morrison). This species has been bred from *Solanum carolinense.* The male scarcely differs from the female of Loew's description. One specimen has smoky wing bands rather than brown ones.

Œdicarena diffusa n. sp. (Pl. VII, f. 9).

Male and female. Large, yellow, bristles and hairs unicolorous. Head swollen, front rather broad, projecting anteriorly, bristles strong. Third antennal joint very short, rounded, arista slender; second joint with bristlet. Face white, in profile receding, a little prominent near the middle; antennal foveæ well marked, separated by a broad triangular area. Cheeks broad, hairy, with one hair bristle-

like. Mouth opening rather large; proboscis small; palpi not broad. Dorsum of thorax with two pale lateral stripes, not always distinct, running from scutellum to suture; the disk of thorax sometimes pale, or of the color of ivory; anterior pair of dorsal bristles considerably behind the suture. Scutellum with four bristles. Metathorax in the middle with a round dark spot. A very distinct black spot occurs just behind the root of the wing. Abdomen pilose, with bristle-like hairs on hind borders of last segment. Ovipositor broad, flat, as long as last two segments of abdomen. Legs stout, front femora with bristles above and below; hind femora with sparse bristles below and those above confined to the distal end. Wings large with a banded pattern, much more diffuse than in allied species; picture yellowish in color, consisting of (1) an indistinct band, beginning at the humeral cross vein; (2) a band starting from the costa at the middle of the second costal cell, traversing the cross veins which limit the posterior basal cells, and uniting with (3) a third band, near the end of the sixth vein; the third band proceeds perpendicularly to the costa and fills out the stigmatical cell; (4) a small band arising upon the costa, bisecting the marginal cell and joining third band near small cross vein; (5) the main band of the wing crosses it over the posterior cross vein and is connected with (6) the sixth band which fills out the tip of the wing along the costa to a little past the end of the fourth vein. The fifth band throws out three branches distally, the first connecting with the second on the fourth vein, enclosing a clear space; the second and third (sometimes absent) reach the margin of the wing in the second posterior cell. Third vein well bristled; lower corner of anal cell produced.

Length of male, 7 mm.; female, 9.5 mm.

Fifteen specimens, Kansas (Williston and F. H. Snow), State of Washington (Morrison).

This species is a true *Œdicarena* which differs from *Spilographa* chiefly in the tumidity of the head, and the straight course of the third vein. The two species which have been previously assigned to this genus have a much simpler wing pattern than *diffusa*, greatly resembling *Spilographa electa*. Both were described from males and the females have never been described. The females of *diffusa* present the character of a broad, flat ovipositor, differing strongly from the short, thick, not at all flattened borer of *S. electa*.

Plagiotoma obliqua Say.

Eastern and Western Kansas.

Trypeta palposa Loew

Four specimens. Kansas (Williston). Two of these agree with

Trypeta sp. Osten Sacken, (Western Diptera, p. 345,) in that the second and third bands of the wing are not connected on the fifth vein.

Trypeta occidentalis n. sp. (Pl. VII. f. 11).

Male and female. Nearly related to *T. palposa*, Loew (Monogr. 1, p. 74, Pl. II, f. 9). The four cross bands of the wing, the first of which proceeding from the costa of the second costal cell, covers the basal cross veins, are distinct and not connected along the fifth vein. In *palposa* the first and second and the second and third bands are thus united. The black on dorsum of thorax is nearly concealed by yellowish-grey pollen and thick appressed pile of same color. The yellow before the scutellum is confined to a rectangular area. The second segment of abdomen with two round black anterior spots on each side of the middle, but no lateral spots as on following segments. Female with abdominal spots as in the male with the addition of the four borne on the sixth segment. Ovipositor yellow or brown with darker tip, longer than the three posterior abdominal segments. Pile of abdomen yellowish except the black bristle-like hairs on posterior margins of segments and the shorter pile of the posterior half of the last segment in the male.

Length, 5.5 to 7 mm.

Five specimens, California; nine specimens, Colorado (F. H. Snow in August).

In the figure the triangular infuscated area arising on the posterior margin of the wing should be omitted: it is due in the insect to a difference in the clearness of the hyaline rather than to any distinct coloration.

Trypeta florescentiae Lin.

Otto, New York (Van Duzee, in July).

Œdaspis montana n. sp. (Pl. VI, f. 5.)

Male. Head yellow. Front broad, dark yellow with slight greenish tinge, pile whitish, bristles black, on the sides anteriorly with three. Antennae very short, third joint nearly as wide as long. Cheeks very broad with some short black as well as whitish hairs; no brown spot or stripe below the eyes. Occiput black above. Thorax short, shining with the usual short bristle-like or stubble-shaped pile. Metathorax black with a broad greyish dusted middle band. Abdomen grey pollinose and whitish pilose, longer than in related species. Legs yellow, front femora somewhat thickened with long blackish pile on under side and a fringe of whitish pile on upper side. The narrow whitish-hyaline wings are without a distinct axillary spot and with three brownish bands. The first band stops at the sixth vein and

does not reach the posterior margin; the first and second very divergent near their origin. These bands are darker on their borders and ends than upon their middle. Cross veins very near together, nearly perpendicular; third vein naked; last segments of third and fourth veins parallel, enclosing a narrow first posterior cell; lower corner of anal cell scarcely prolonged.

Length, 3 mm.

One specimen, Montana (Morrison).

Œdaspis minuta n. sp. (Pl. VI, f. 2.)

A single badly preserved male from Montana (Morrison) affords sufficient grounds in its small size and wing characters, for the introduction of a new species Moreover the face is very short; the eyes are not much longer than wide; the cheeks are of moderate breath; the femora are dark brown except their tips. The pile and bristles of the body are mostly rubbed off. Wings with basal spot and three bands brown. The hyaline intervals whitish; the bands are of subequal width, the first one being slightly the broadest; the second and third bands barely come in contact on the third vein. The first and second bands are much more divergent at their beginning than in *Œ. atra* Loew (Monogr. III, Pl. XI, f. 17); cross veins perpendicular, not as approximate as in the preceding species; third vein without bristles; lower corner of anal cell slightly drawn out.

Rhagoletis pomonella Walsh. (Pl. VI, f. 3.)

Specimens of both sexes from Michigan, District of Columbia (date of June 15) and Maine (Harvey), are blacker in color than is indicated by Loew's description (Monogr. III, p. 265). The black stripe on the anterior femora is sometimes lacking. As Loew's description applies only to the female, it may be added that the male besides being somewhat smaller, has three whitish abdominal bands instead of four as in the female; the hairs of the hypopygium are white; the femora are darker.

The wing band that covers the posterior cross vein is generally a little broader at the middle, and longer than in the specimen figured, which was a little faded.

Rhagoletis zephyria n. sp. (Pl. VI, f. 1.)

Male. Similar to *R. pomonella* but much smaller. Blackish-brown, the pleuræ and femora more brown; the two pollinose stripes each side of the middle line of the dorsum obsoletely divided; the dark brown bands of wings of lighter color than in *pomonella;* the fourth band fills out the tip of wing to greater extent; the hyaline

space between second and third bands reaches the fourth vein, while in *pomonella* it ends some distance below; the cross veins are less approximate. The wing bands are too dimly brought out in the figure.

Length, 2.5 to 3 mm.

Three males from Southern California. Considerable variation exists in the depth of color of the body and wings.

Two other males (Pl. VI, f. 4) from same locality show varietal differences, perhaps, in the wings. The hyaline space between the first and second bands is narrower; the similar space separating the second and third bands is somewhat shorter; and the one between the third and fourth bands stops abruptly at the third vein; the cross veins are slightly more approximate. In other respects they agree with the foregoing.

POLYMORPHOMYIA n. gen.

Front narrow; eyes very large and cheeks exceedingly narrow; thorax greatly rounded, globose; scutellum rather flat, four bristled; abdomen short, rounded, convex; ovipositor short, flat, triangular; pile of whole body stubble-shaped, or almost like short bristles, easily rubbed off. Wings very broad, convex anteriorly and posteriorly, tip obtusely rounded; a black *Aciura*-like picture; cross veins nearly in the same line, oblique; lower distal corner of discal cell widely prolonged; anal cell also widely drawn out at lower corner; third vein bristly.

Here is displayed a remarkable combination of characters. The pattern of the wing coloring strongly resembles that of *Aciura*; the hyaline distal lunule is repeated in *Platystoma lunulata* (figured by Macquart, Dipteres Exotiques, 4th Supplement, Pl. XXVI, f. 3); the proximity of the cross veins and the stubble-like pile point to *Œdaspis;* and the prolongation of the lower corner of the discal cell is found in the exotic genera *Anomoia* and *Ceratitis*.

Polymorphomyia basilica n. sp. (Pl VII, f. 1)

Female. Black shining; pile of whole body whitish, sparse and stubble-shaped or almost scale-like; bristles black.—Head obscure yellow; front more reddish, rather narrow, not at all prominent, with pile as described above and black bristles. Antennae nearly reaching oral margin; third joint rounded anteriorly. Face receding a very little; edge of mouth not projecting; proboscis short, flaps not geniculate. Eyes large. Cheeks extremely narrow. Occiput black. Thorax globose, the characteristic pile thinly covering the dorsum and pleurae; the first of the two pairs of dorsal bristles are sutural. Scutellum moderately large, rather flat, four bristled. Abdomen

short, exceedingly convex, with pile as on the thorax; bristles on the last segment. Ovipositor short, flat, triangular. Tips of tibiae and the tarsi yellow. Wings very broad, with extremely wide obtuse tips; picture black with hyaline spots and indentations; the black fills out the immediate tip only narrowly as a long cresentic hyaline baud parallels the costa of the tip and relieves the otherwise solid black picture of the distal third of the wing. In addition to the hyaline indentations along the borders of the wing, there are two clear drops, one on each side of the small cross vein; a narrow spot at the end of the anal cell; and a small spot in the discal cell on the anterior side of the fifth vein. The third vein is bristly; the cross veins are almost in the same line. The posterior cross vein is doubly curved; its posterior end is much nearer the tip of the wing than its anterior end, and the discal cell is consequently considerably prolonged below. The lower corner of the anal cell is widely drawn out.

Length, 4 mm.

One female specimen from San Domingo (Frazar).

XENOCHÆTA n. gen.

Front very broad. Antennae shorter than face. Face perpendicular, short; the oral edge not prominent. Cavity of the mouth moderately large; proboscis short, flaps apparently not at all geniculate; palpi broad. Eyes nearly round, yet the cheeks narrow. Scutellum not swollen, with six bristles. Wings with a blackish picture of large irregular spots or blotches. Third vein almost naked, and fifth vein entirely devoid of bristles; cross veins not very near together, perpendicular; anal cell but slightly drawn out at lower corner.

Xenochæta dichromata n sp. (Pl. VII, f. 2.)

Male. Black and yellow, shining.—Head reddish-yellow. Front darker, very wide, half the head or a little more in width; bristles black, weak. Antennae a little shorter than face; third joint sharp anteriorly; arista with short pubescence, thickened at base. Face short, perpendicular; oral margin scarcely projecting. Oral cavity moderately large; proboscis small; palpi very broad, not extending beyond edge of mouth. Eyes nearly round; cheeks narrow, with some yellowish pile. Occiput blackish on upper half. Thorax black, with black pile plentifully mixed with yellow; bristles black. Scutellum mostly black above and yellow below; a spot on either side and one at the apex yellow; with six bristles, four strong, black, lateral ones and two approximate, weak, yellow ones erected upon the apical yellow spot. Abdomen short, wide at end of second segment and

narrowed almost to a point posteriorly; yellow, spotted with black; first segment obscurely black at base; second segment with two large lateral black spots; following segments each with four similar spots, so large and close together as to leave little room for the yellow; pile rather long, glistening yellow on the yellow ground color, and black on the spots. Legs strong, yellow, with the usual bristles yellow. Wings of a very moderate breadth, tip narrower; the blackish picture is neither banded nor reticulate, but with large irregular spots; a square spot nearly filling the stigma, reaches the third vein; a very large irregular spot fills the discal cell completely and the adjacent cells partially, leaving in the third posterior cell two large clear spots, the smaller one at the base and the larger one in the posterior portion of the cell; a large apical blackish spot covers over the first posterior cell except the base, fills out the ends of the marginal and submarginal cells and laps over the fourth vein into the second posterior cell; the humeral cross vein is broadly infuscated; a small black spot in the second costal cell lies next the costa; third vein with very few bristles near the base; fifth vein bare; lower corner of anal cell slightly drawn out; cross veins steep, not very near together.

Length, 3.5 mm.

One specimen, Mt. Hood (Morrison).

This species cannot be well placed in any of the genera already established. The broad front, narrow cheeks, six bristled scutellum, peculiar pile, and odd wing picture sufficiently isolate it as the type of a new genus. In two other North American genera the scutellum bears six bristles, namely: *Hexachæta* and *Blepharoneura*, but *Xenochæta* cannot by any means be confused with these, which are characterized especially by their alar picture and the presence of bristles on the fifth vein.

Eutreta sparsa Wied.

Five males and three females, White Mountains, Maine, Buffalo, New York (Van Duzee); are typical specimens.

Other western specimens show varietal differences at least. A male and female (Pl. VII, f. 10), California, have wings narrower than do the eastern specimens, with the rather dim pellucid drops extending to the costa anteriorly, varying in size and arranged with little regularity. Drops occur even in the first and third costal cells.

Length, 5.5 mm.

A single male, State of Washington (Morrison), agrees in size with typical specimens, but has the yellowish drops of the wings largely confluent in the middle and basal regions, and reaching the costa anteriorly.

Another male (Pl. VI, f. 11), California, is but 3.5 mm. long. The light dots on the wings are large, the posterior cross vein is considerably bent and the abdomen is uniformly blackish.

Eutreta diana O. S.

A male bred from *Artemesia* sp. by Prof. F. H. Hillman, Reno, Nevada, June 20, is nearly related to this beautiful species. A comparison with Osten Sacken's description shows the following differences:—Length, 4 mm.; front opaque yellow, and not reddish as in *diana;* face white, while from the description it is presumably black with white pollen; abdomen blood red except fifth segment and hypopygium and two anterior bars, not reaching the sides, on third and fourth segments, which are black. In *diana* the black is confined to the last two segments, with a narrow posterior border of red on the penultimate segment. The posterior cross vein is perpendicular and strongly curved, and the drops, while small, are very white and distinct. In *diana* the posterior cross vein is oblique and only gently curved and the drops are faint.

A female from Montana differs from the male in the lighter color of the legs; the abdomen is entirely red and the ovipositor reddish-black.

With only the description for comparison it may be premature to assign these specimens to a new species. They may be called, however, variety *tricolor*.

Eutreta longicornis n. sp. (Pl. VI, f. 12.)

Easily distinguished by its very long third antennal joint and small size.

Male. Shining black, with sparse whitish pubescence. Front opaque brownish-yellow, a little shining before the antennae, bristles blackish, those of posterior orbit white and thick. Antennae very long, reaching the oral margin, black with fine whitish pubescence; third joint twice as long as the other two together. Face brown, shining, somewhat excavated; cheeks with yellow pile. Palpi small, almost concealed, apparently blackish at tip. Occiput black, rather swollen. Legs brown, tarsi yellowish. Wings with the characteristic picture. Small cross vein oblique; posterior cross vein almost perpendicular and considerably curved; the hyaline drops of the wing reach the margin only behind the tip of fifth vein. In the discal and third posterior cells and anal region, the drops enlarge and are more or less confluent. The second basal and anal cells are nearly hyaline.

Length, 3.5 mm.

One specimen, Montana (Morrison).

Carphotricha culta Wied.
Eastern and Western Kansas, Colorado.

Eurosta solidaginis Fitch. (Pl. VII, f. 5.)
Numerous specimens showing considerable variation. Eastern specimens (figured), Maine, Connecticut, measure 5 mm. in length, wings, 5 mm. Two of these bear date of May 23. Others from central Illinois are 6.5 to 7 mm. long; wings, 7 mm., with wing picture of a much darker brown than in the foregoing. In nearly all the specimens the large hyaline spot which arises upon the basal posterior border of the wing, extends nearly if not quite to the third vein; in one it stops abruptly at the fifth vein. There are usually a few light spots in the second costal cell. It is well to add to Loew's description (Monogr. I, p. 82) that the hairs of the thorax are golden; the abdominal segments are normally banded with black anteriorly and their pile is yellowish-white, except at the base of the segments, where it is black; the ovipositor while very convex above is flattened ventrally; scutellum often somewhat bilobate at tip.

Eurosta comma Wied. (Pl. VII, f. 3.)
Four specimens, Connecticut, Virginia (Sept. 23), vary in depth of color and distinctness of wing-drops. In one the hyaline spot at the end of sixth vein is very large. The figure is not dark enough.

Eurosta fenestrata n. sp. (Pl. VII, f. 7.)
Female. Light brown. Head yellowish; front with weak brownish bristles. Face quite deeply excavated, oral margin projecting and drawn up anteriorly; oral opening of moderate size; palpi brownish at tip, broad and extending past the edge of the mouth. Eyes much longer than wide. Cheeks broad, with one or two stoutish bristle-like hairs. Dorsum of thorax covered thickly with yellowish pollen and glistening yellow pile. The very convex scutellum with two, large, lateral, brown spots and two bristles. Metathorax dark brown with yellow pollen. Pleurae with blackish bristles, a few yellow hairs, and thickly dusted with yellow. Abdomen rather slender, bright brown, mostly yellow pilose, and dusted with the same color, especially on the last segments; a not very distinct pollinose stripe down the middle; each segment at base with a subobsolete darker band. Ovipositor reddish brown, shining, narrowly black at tip, conical, not flattened beneath. The sixth segment is equal in length to the fifth. It is much shorter than the fifth in the female of *solidaginis*. Legs yellowish-brown, tarsi more yellow, rather long. Wings moderately broad, very obtuse at tip, in pattern of picture resembling *comma* but with more hyalinity. Two large clear drops occur in the second

costal cell; the usual hyaline space beyond the tip of first vein is clearly defined, ending abruptly at third vein; there is a small drop just beyond the ending of the second vein; the hyaline of tip interrupted on third and fourth veins, the spot arising at end of sixth vein is large and invades the discal cell; the specimen described has an adventitious cross vein in both wings, between the second and third veins, bisecting the submarginal cell; third vein with much stronger bristles than in *solidaginis*.

Lengh, 7 mm.

A single specimen from Arizona (Morrison).

This species is allied to *E. comma* but is smaller and of lighter color. Its face is more deeply excavated, the oral margin- more projecting, and the palpi more exserted; abdomen slenderer than in allied species, with pile mostly yellow, while in *comma* it is black; the wings differ in their picture.

Eurosta reticulata n. sp. (Pl VII, f. 6.)

Male and female. Dark brown.—Head of a yellowish-brown. Front very wide with weak black bristles, slightly darker than the face. Antennae short, clay yellow; third joint with an anterior angle, arista incrassate at base. Face quite strongly excavated, on the sides below with a few short hairs; oral border projecting, mouth rather large. Eyes moderately large, of greater extent than in *solidaginis*. Cheeks broad, with stout light colored pile. Proboscis short. Palpi broad, extending beyond oral margin. Thorax broad, dark, dingy brown, blacker on the dorsum; with short whitish pile and light colored pollen, through which the brown of the ground color shows in small round spots. Scutellum very convex, with four bristles. Metathorax black. Abdomen broad, dark brown, with a pollinose light stripe down the middle, and similar pollen in irregular patches, especially on the margin and sides of segments. The brown shows through the pollen in small round spots, very much as in the Ortalid, *Stictocephala vau*. Ovipositor conical, a little flattened at tip in one specimen; black, or partly dark red. Legs yellowish-brown, femora darker. Wings broad, with very obtuse tip, more evenly reticulate than in *solidaginis;* the picture a deep brown; the hyaline predominates from near the tip of sixth vein anteriorly to middle of wing; at the tip of wing, broadly, and just distad of the end of the first vein; cross veins perpendicular; bristles of third vein well developed.

Length, 6 to 7 mm.

Three males and one female, Connecticut; one female from Montana (Morrison).

The Montana specimen is a little larger than the others and has

the brown spots of the abdomen more distinct. In two of the eastern specimens, which are not well preserved, the spots are obsolete. The ovipositor of the western female is broader and more depressed at tip than in the other case.

While differing from its congeners in the four-bristled scutellum, this species has in common with them, a broad front, great breadth and convexity of body, short conical ovipositor, and broad, obtusely tipped, reticulate wings. Its generic location is therefore easily ascertained.

While the wing of *reticulata* resembles that of *latifrons*, it is more guttate and lacks the large dark "convexity" or callosity in the first posterior cell.

Icterica seriata Loew.

Two specimens, male and female, Nebraska (Williston).

Loew's description being based upon the male, it may be added that the ovipositor is flat, a little longer than the last two abdominal segments, black at tip.

Euaresta æqualis Loew. (Pl. VII, f. 10.)

Trypeta (*Euaresta?*) sp. O. Sacken (Western Dipt., 345).

Trypeta æqualis Marlat (Ins. Life, III, 312, f. 27, 28).

There can be little doubt that Loew erred in the characterization of this species when he called the third vein devoid of bristles. Specimens before me from Pennsylvania, Virginia, Illinois and New Mexico, all show distinct bristles on their third vein; otherwise they agree closely with Loew's description. The picture of the wing is essentially the same in all. The black stripes of the anterior femora which Osten Sacken observed in his Colorado specimens (l. c.) are evident in these specimens, except in the case of two females from Nebraska and Virginia respectively.

It may be added to Loew's description that the anterior femora of the male are much thickened. The ovipositor is reddish-brown, narrow, not at all flattened and about as long as the last four abdominal segments taken together.

Euaresta festiva Loew. (Pl. VI, f. 9.)

Kansas (F. H. Snow, Williston, in August); Virginia (C. J. Bridge, Aug. 31).

Euaresta bella Loew.

Many specimens. Everywhere one of the commonest Trypetids.

Euaresta bellula n. sp.

Male and female. Head yellow; front with a greenish tinge and antennae more ferruginous; frontal bristles reddish. Antennae nearly reaching anterior border of mouth; third joint broad. Face descending straight to the oral margin which projects slightly. Oral opening large. Cheeks very narrow. Thorax black, thickly dusted with yellowish grey, yellow pilose. Scutellum yellowish at tip, with four bristles. Metanotum black, shining through the greyish pollen. Abdomen reddish-brown, sometimes darker; blackish at tip, shining, with fine yellowish pile, especially on hind borders of segments. Ovipositor black, longer than the last two segments, with very small light hairs. Legs yellow, front femora of male swollen. Wings strikingly narrow; third vein without bristles, at the utmost a few small ones on prefurca; posterior cross vein oblique; the pattern of the dark brown picture is similar to that of *E. mexicana* Wied. (Loew, Monogr. III, p. 317, Pl. X, f. 28); it differs from *E. bella* (Pl. VI, f. 8) in that the clear drop which in the later species lies above the small cross vein, is here a part of the hyaline space which arises upon the costa at the end of the first vein; the fifth and sixth rays of *bella* are joined in the present species to form one broad ray filling up the tip of the marginal cell. The wings are sufficiently distinguished from those of *mexicana* by the absence of any clear drop and the presence of a deep colored callosity in the first posterior cell; by the large size of the drop in the first basal cell, coequal in its diameter with the width of the cell; by the presence of another very large drop in the upper distal corner of the discal cell; and by a pattern rather more radiate than guttate in the third posterior cell.

Length, 2.5 to 3 mm.

Three males and one female, Arizona (Morrison).

Tephritis affinis n. sp. (Pl. VII, f. 12.)

Male and female. Very nearly related to *T. finalis* Loew (Monogr. III, p. 296, Pl. XI, f. 4) but differs in the third vein being bristly, in the great length of the last abdominal segment of the male, in the presence of black pile on the anterior half of abdominal segments, and in shape of the wings which are more obtuse at the tip and with sides more nearly parallel, as compared with Loew's figure (l. c.).—Head yellowish; front, antennae and palpi more saturate, though the former is narrowly whitish on the sides. Face descending straight to the somewhat projecting oral edge; mouth opening large. Thorax blackish, on the humeral and ante-alar callosities yellow; dusted with yellowish grey and with short light colored pile. Scutellum with four black bristles; on the apex broadly yellowish. Abdomen similar in

color to thorax, with longer yellowish pile which is restricted to the posterior half and the sides of the segments; the anterior portions are covered with short bristly black pile; longer hairs of last segment black; last segment in male nearly three times as long as penultimate, in the female only slightly longer. Ovipositor longer than last two segments, red, blackish at base and tip. Legs brown. Wings proportionately long, hardly differing in design of picture from *finalis;* the clear spots of the posterior basal portion are more confluent.

Length of male, 4.5 mm.; of female, 5.5 mm.

Two males and three females, state of Washington (July 16), Montana (Morrison), and Kern county, California.

Tephritis albiceps Loew.

Three specimens, White Mountains (Williston) and Canada.

Tephritis picturata n. sp.

Male and female. Head yellowish. Front moderately wide, scarcely narrowed anteriorly, with sparse whitish pile and brown bristles. Antennae more saturate yellow, not reaching the oral margin; anterior corner of third joint rounded. Oral border projecting. Proboscis short-geniculate, flaps broad. Palpi pale, with white pile. Cheeks exceedingly narrow. Occiput with two blackish oblong spots above. Bristles of posterior orbits and vertex whitish. Thorax densely dusted with yellow; hairs pale; bristles dark, the dorsal pair near the suture. Ground color of dorsum black, of sides yellow. Scutellum yellow, with four bristles. Metathorax black. Color of abdomen variable reddish or blackish, in the latter case with light colored hind margins of segments; pile short, appressed, reddish. Ovipositor yellowish-red, narrowly black at tip, flattened and as long as last two abdominal segments. Legs yellow. Wings covered with a yellowish and blackish reticulation. Its darkest portions are near the end of the second vein, and two black spots in stigma, one on tip of auxiliary vein and the other near tip of first vein; the remainder of the stigma is yellow; along veins picture mostly yellowish, while surrounding clear drops, blackish prevails; just past tip of second vein is the largest hyaline spot of the reticulation, extending to third vein; and almost touching it distally is a smaller one which does not reach second vein; a distinct clear drop occurs at end of second vein; a clear drop on each side of anterior cross vein; the third and fourth veins each pass between two connected drops just before they reach the costa; posterior half of wing with numerous large and small drops.

Length, 4 mm.

Nine specimens, Florida (Frazar).

Easily separated on account of the bicolorous reticulation of the wings.

Tephritis obscuripennis n. sp. (Pl. VII, f. 8.)

Male. Black.—Head yellow; front and antennae more saturate. Front very broad, bristles black. Antennae short, third joint rounded anteriorly. Face with a whitish bloom, perpendicular, somewhat excavated. Oral opening moderately large, a little longer than wide, and drawn up anteriorly. Cheeks rather wide. Occiput black. Thorax with golden pile and black bristles; humeral callosities yellowish. Scutellum yellow at apex. Pile of abdomen yellow with a few black hairs; a light pollinose stripe in the middle; on the sides, pollen more brown; last segment as long as two preceding segments together. Legs yellow, femora except the tip black. Wings rather long, only moderately narrow, almost covered with a brown design which is less reticulate than in related species; the stigma has a hyaline spot near the tip of first vein; third vein bare; posterior cross vein slightly oblique.

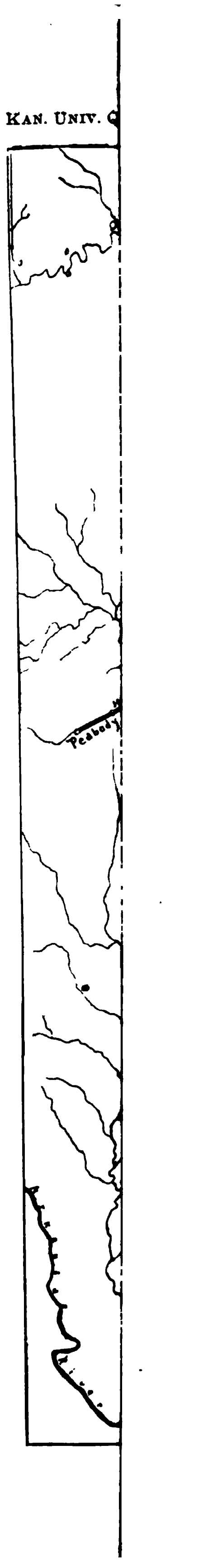
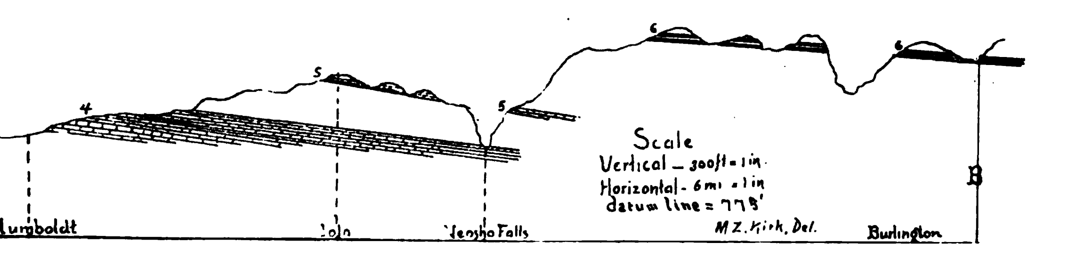

KAN. UNIV. Q
Peabody

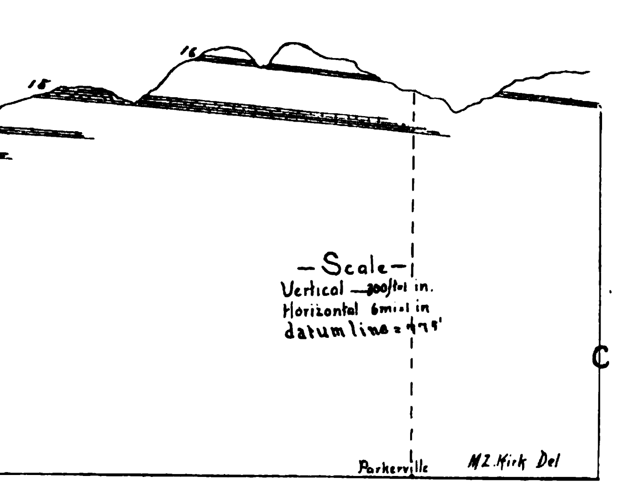
PLATE IV.

Figure 1 represents a geological section along the Neosho river from the northwestern limit of the Mississippian formation in the Indian Territory to Burlington. The limestone systems only are represented.

Figure 2 is a continuation of the geological section shown in figure 1, and reaches from Burlington to White City. The station Dunlap was erroneously spelled Dunlop.

Figure 3 is a section along the Cottonwood river from Wyckoff to Peabody. It connects with figure 2 at D.


4
5
5
6
6
Scale
Vertical – 300ft = 1 in.
Horizontal – 6 mi = 1 in
datum line = 775'
M.Z. Kirk, Del.
B
umboldt
Iola
Neosho Falls
Burlington


15
16
– Scale –
Vertical – 300ft = 1 in.
Horizontal 6 mi = 1 in
datum line = 775'
C
Parkerville
M.Z. Kirk Del

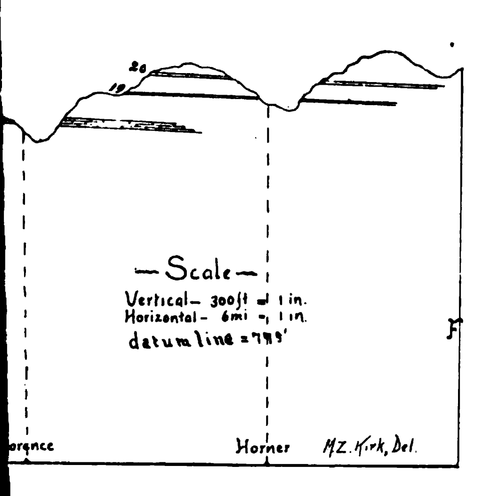

20
19
– Scale –
Vertical – 300ft = 1 in.
Horizontal – 6 mi = 1 in.
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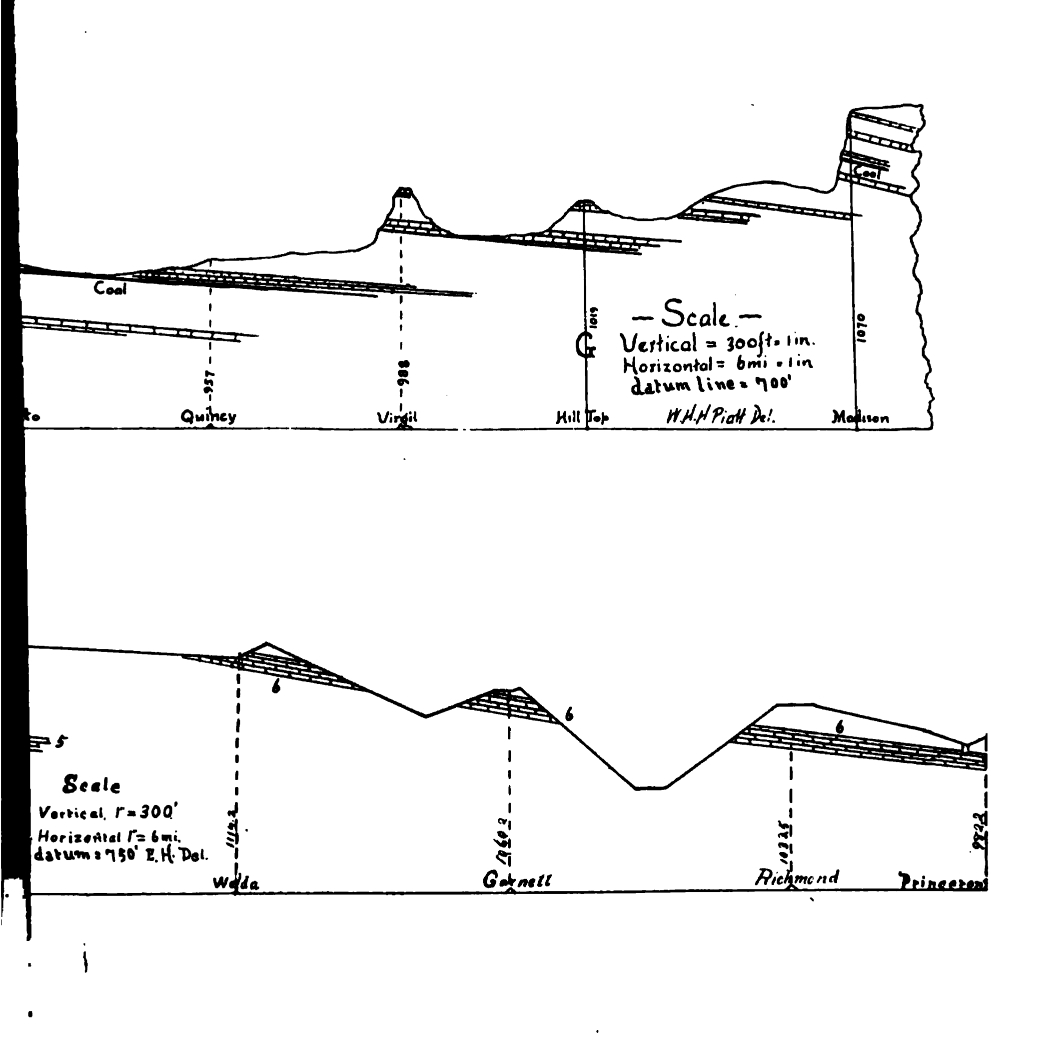
PLATE V.

Figure 1 represents a geological section along the Verdigris river from the south line of Kansas to Madison. The limestone series only are represented.

Figure 2 is a geological section from Liberty to Princeton along the A., T. & S. F. R. R. The contour lines were obtained from a condensed profile of the road. The mounds shown at 3 and 4 are located near the road, and are brought into the section. In different places, such as between Garnett and Richmond, the road passes along a valley so that the rocks can be seen continuously along the adjacent bluff.

Figure 3 is a continuation of figure 2, and extends to the bluffs north of Lawrence. The high ground north of Baldwin lies close enough to the line of the road to justify its representation in the figure. At Lawrence the point of University hill is shown, and the high bluffs to the north, with the broad and deep valleys of the Wakarusa and the Kansas rivers between.

Figure 4 is a section along the A., T. & S. F. R. R. from Ottawa to Holliday.



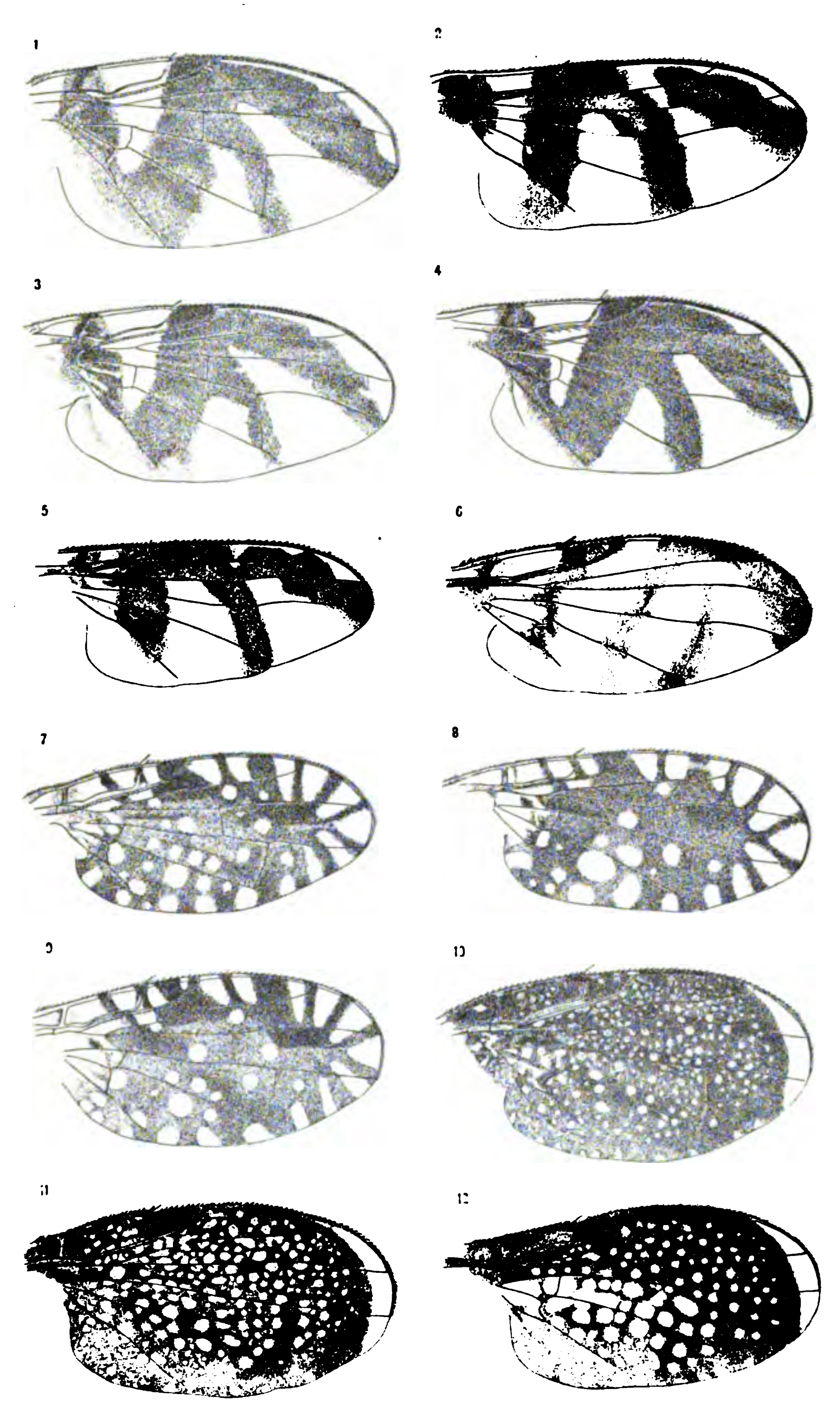
Scale
Vertical. 1" = 300'
Horizontal. 1" = 6 mi.
datum line = 750' E. H. Del.

Edgerton Gardner Olathe Zarah Holliday

Fig. 4.

PLATE VI.

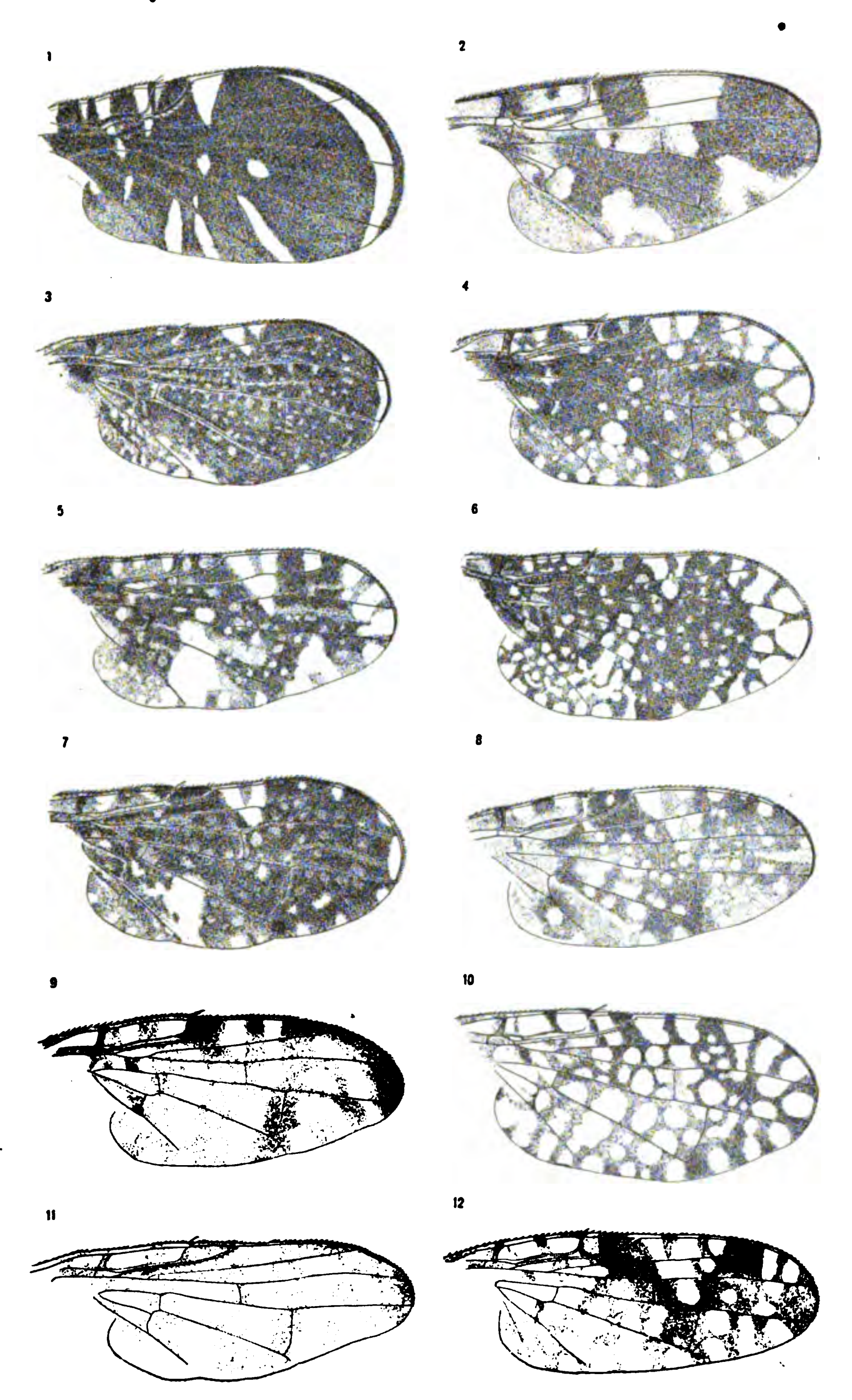
Fig. 1. *Rhagoletis zephyria* Snow.
Fig. 2. *Œdaspis minuta* Snow.
Fig. 3. *Rhagoletis pomonella* Walsh.
Fig. 4. *Rhagoletis zephyria* Snow, var.
Fig. 5. *Œdaspis montana* Snow.
Fig. 6. *Epochra canadensis* Loew.
Fig. 7. *Euaresta festiva* Loew, var.
Fig. 8. *Euaresta bella* Loew.
Fig. 9. *Euaresta festiva* Loew.
Fig. 10. *Eutreta sparsa* Wied., var.
Fig. 11. *Eutreta sparsa* Wied., var.
Fig. 12. *Eutreta longicornis* Snow.



Mary H. Wellman and S. W. Williston, ad nat. del.

PLATE VII.

Fig. 1. *Polymorphomyia basilica* Snow.
Fig. 2. *Xenochæta dichromata* Snow.
Fig. 3. *Eurosta comma* Wied.
Fig. 4. *Eurosta* sp.
Fig. 5. *Eurosta solidaginis* Fitch.
Fig. 6. *Eurosta reticulata* Snow.
Fig. 7. *Eurosta fenestrata* Snow.
Fig. 8. *Tephritis obscuripennis* Snow.
Fig. 9. *Œdicarena diffusa* Snow.
Fig. 10. *Euaresta æqualis* Loew.
Fig. 11. *Trypeta occidentalis* Snow.
Fig. 12. *Tephritis affinis* Snow.



W. A. Snow and Mary H. Wellman, ad nat. del.

PROSPECTUS.

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The Control of the Purse in the United States Government.

BY E. D. ADAMS.

Introduction.

The investigation outlined in the following pages, of those provisions of the constitution which relate to the control of financial matters, was originally undertaken with the idea of tracing the development of the principle of self-taxation in England, and of noting how that principle came to be introduced into the United States. It was found that a study of budgetary control by the Commons in England amounted to little less than a study of the growth of the English constitution, so that it seemed best to confine the thesis to the consideration of the great provisions of the constitution of the United States, and to trust to the reader to remember that the presence of an article in the constitution, granting to the House the privilege of originating revenue bills, is due to the long recognized principle in England, that the people, through their representatives in the Commons, should control the extent and purpose of taxation.

The history of the introduction of the constitutional restriction referred to has been condensed also, so that the greater portion of the thesis is devoted to the various debates in Congress upon the correct interpretation of the constitution. These debates show that the House of Representatives has put a broader construction upon its privilege than was intended by the constitutional convention, and has practically assumed supreme control over all financial matters. Under these circumstances the natural inquiry is, whether or not the House of Representatives secures to the people of the United States that direct control over money matters which was intended by the constitutional provision. In this connection a brief account is given of the business organization of Congress and the effect of that organization upon the responsibility of representatives.

Of the two main parts of the thesis, the historical account traces fully the various interpretations of the constitutional provision, while lack of space compels a condensation of the conclusion involving many abrupt transitions.

AUTHORITIES.

UNITED STATES:— Madison Papers; Elliott's Debates: Bigelow, American Constitutions; American's Guide to State Constitutions; Poore, Charters and Constitutions; Annals of Congress; Journal of the House of Representatives; Congressional Debates; Congressional Globe; Congressional Record; House of Representatives Reports; Senate Reports; Peters, United States Statutes at Large; Smith, Digest of the Rules of the House; Reade, Digest of the Rules of the Senate; Hildreth, History of the United States; Greely, American Conflict; Wilson, Congressional Government; Stickney, a True Republic; Correspondence on the Budget, Cobden Club; North American Review, vols. 26, 108, 111, 128; The Atlantic Monthly, vol. 55; The Nation, for April 4; 1878; Stevens, Life of Albert Gallatin.

ENGLAND:— Statutes of the Realm; Hansard's Debates; May, Parliamentary Practice; Anson, Law and Custom of the Constitution; Feilden, Short Constitutional History of England.

A.—Debates in the Constitutional Convention on the Origination of Money Bills.

The Revolution of 1688 had firmly established the principle that taxation in England must be controlled by Parliament. The famous demand of the Americans in 1776 of "No taxation without representation" was but a claim to political liberty equal to that which had been enjoyed by the mother country for nearly a hundred years. The effect of the arbitrary government of Charles I upon the England of 1640 found its counterpart in the effect of the government of George III upon the America of 1776. The war of the Revolution firmly established the principle of self-taxation in America, though it was a principle which had long been asserted in colonial charters and constitutions.

As in England, when the principle of self-taxation was once firmly established, the history of the budget is concerned with the relations between the Crown, the Lords and the Commons, and is to be found rather in the standing orders of the two houses, than in the statutes of the realm, so in the United States the history of the budget is confined to the various provisions pertaining to the origination of

money bills, and to the powers of the two houses in regard to them. The clause in the constitution which provides that all money bills shall originate in the House of Representatives, is preceded in time by various provisions in the state constitutions. In 1776, eight of the states adopted new constitutions, and of these, five contained provisions that all money bills must originate in the lower house. Many of these provisions are similar to that of Massachusetts, adopted in 1780: "All money bills shall originate in the House of Representatives, but the Senate may propose or concur with amendments as on other bills;"* but some of the state constitutions also contain provisions which are intended to prevent the lower house from abusing this privilege by the tacking of riders to money bills.† The idea that the lower house is more fit to discuss matters of taxation, because its members are more directly the representatives of the people, was undoubtedly an outgrowth of the principle of the English constitution that the Commons should make all grants to the Crown.‡ But its adoption by six states does not prove that it was an idea fully accepted by all the people, for other state constitutions previous to 1787 had no such provision. More than that, in the constitutional convention, many of the delegates from these six states were opposed to the introduction of a similar provision into the constitution of the United States.

Art. III of Pinckney's plan§ for a federal union, submitted to the convention on May 29th, 1787, provided that all money bills of every kind should originate in the House and should not be altered or amended by the Senate. In the first debate upon this question, the leading members of the convention were in the main opposed to giving any such exclusive privilege to the House, and the article was defeated by a vote of the states of seven to three.|| But on July 5th

*Constitutions and Charters of the United States, Poore, Vol. I, p. 956.

†Art. X of the constitution of Maryland, which was adopted in 1776, declares that "The House of Delegates may originate all money bills." Art XI provides "In order that the Senate * * * may not be compelled by the House of Delegates, either to reject a money bill which the emergency of affairs may require, or to assent to some other act of legislation, in their conscience and judgment injurious to the public welfare, the House of Delegates shall not, on any occasion or under any pretext, annex to or blend with a money bill any matter, clause or thing not immediately relating to and necessary for the imposing, assessing, levying or applying the taxes or supplies to be raised for the support of the government or the current expenses of the state: and to prevent altercation about such bills it is declared that no bill, imposing duties or customs for the mere regulation of commerce, or inflicting fines for the reformation of morals, or to enforce the execution of the laws, by which any incidental revenue may arise, shall be accounted as a money bill: but every bill assessing, levying or applying taxes or supplies for the support of the government or the current expenses of the state, or appropriating money in the treasury, shall be deemed a money bill." Bigelow, American Constitutions, p. 222.

The constitution of Delaware also makes provision against the same danger. Art. II, Sec. 14, reads: "All bills for raising revenue shall originate in the House of Representatives, but the Senate may propose alterations as on other bills; and no bill, from the operation of which when passed into a law, revenue may *incidentally* arise shall be accounted a bill for raising revenue; nor shall any matter or clause whatever, relating to and necessary for raising revenue, be in any manner blended with or annexed to a bill for raising revenue." American's Guide for State Constitutions, p. 187.

‡Madison Papers, Vol. II, p. 855, Speech of Butler.

§Ibid., p. 737.

||Ibid., p. 858.

Franklin made a report* which contained three principal points. First, that the members of the House should be apportioned on the basis of population. Second, that all money bills should originate in the House.† Third, that the states should have equal representation in the Senate. Thus the origination of money bills was made a part of the struggle between the large and the small states over the question of representation, and it would be but natural to expect to find the large states in favor of and the small states opposed to this proposition of Franklin. But many of the most influential members from the large states did not believe in the wisdom of such a provision.‡ Madison, of Virginia, opposed it throughout, declaring that the Senate was as much the representative of the people as was the House, and would undoubtedly be composed of a class of men more capable of dealing with financial questions than would the House. Of the same mind were Morris§ and Wilson‖ of Pennsylvania, and Williamson** of North Carolina, while the members most earnest in support of the provision were Gerry of Massachusetts, Mason of Virginia and Franklin of Pennsylvania. Gerry said "it would establish the constitutional principle that the second branch were not possessed of the confidence of the people in money matters."†† Franklin thought that those who were nearest the people should distribute the people's money on the principle that "those who feel can best judge."‡‡ On the question whether the clause reading "All bills for raising revenue shall originate in the first branch of the legislature, and shall not be amended or altered by the second branch," the vote stood Connecticut, New Jersey, Delaware, Maryland, North Carolina, Yes, 5. Pennsylvania, Virginia, South Carolina, No, 3. Massachusetts, New York, Georgia, Divided, 3.§§

It is evident from this vote that the small states were offering an inducement to the large states which the large states either were unwilling to accept, or did not regard as wise. By a majority of the members of the convention the matter was not looked upon as a

*Madison Papers, Vol. II, pp. 1024, 1036.

†The provision read "that all bills for raising or appropriating money, and for fixing the salaries of the officers of the Government of the United States, shall originate in the first branch of the legislature, and shall not be altered or amended by the second branch." —Elliot's Debates, Vol. V, p. 274.

‡Madison Papers, Vol. II, p. 857.

§Ibid., p. 1041.

‖Ibid., p. 1041.

**Ibid., p. 1043.

††Ibid., p. 1043.

‡‡"Dr. Franklin did not mean to go into a justification of the report, but as it had been asked what would be the use of restraining the second branch from meddling with money bills, he could not but remark that it was always of importance that the people should know who had disposed of their money and how it had been disposed of. It was a maxim that those who feel can best judge. This end would, he thought, be best attained if money affairs were to be confined to the immediate representatives of the people. This was his inducement to concur in the report."—Elliott's Debates, Vol. V, p. 284.

§§Madison Papers, Vol. II, p. 1045.

question of much constitutional importance but simply as a convenient subject upon which to base a compromise. Madison in an explanatory note says of the situation, "Col. Mason, Mr. Gerry and other members from large states set great value on the privilege of originating money bills. Of this the members from the small states, with some from the large states, who wished a high mounted government, endeavored to avail themselves, by making that privilege the price of arrangements in the constitution favorable to the small states, and to the elevation of the government."* The proof that the small states really cared nothing for the restriction as a constitutional principle is found in the vote taken on August 8th. By that time it had been decided that the states were to have equal representation in the Senate, and this point once gained, the small states were by no means so eager to support the provision restricting the origination of money bills to the House. Madison had always been a consistent opponent of such a measure and he now attempted to have the convention revoke its previous decision. On the question of striking out Art. IV, Sec. 5,† of the report of the committee on detail, the vote stood‡ New Jersey, Pennsylvania, Delaware, Maryland, Virginia, South Carolina, Georgia, Yes, 7. New Hampshire, Massachusetts, Connecticut, North Carolina, No, 4. This breach of faith on the part of the small states, aroused the indignation of those delegates from the large states who were earnest in their desire to see the origination of money bills confined to the House of Representatives. The next day, August 9, Randolph§ of Virginia said that if Art. IV, Sec. 5, was not reinstated, he would oppose equality of votes in the Senate, and in this he was followed by Gerry, Franklin and others who had voted for the section in question. This brought on a renewal of the debate in the course of which it was asserted that the section as proposed would prevent the Senate from originating any bill, which might in any way affect the treasury. In order to overcome this objection, Randolph moved to amend by substituting the following clause: "Bills for raising money for the purpose of revenue, or for appropriating the same, shall originate in the House of Representatives, and shall not be altered or amended by the Senate so as to increase or diminish the sum to be raised, or change the mode of levying it or the object of its appropriation."|| This amendment was, it is true, a solution of the difficulty mentioned, but at the same time it provided for just as great a restriction upon the

*Madison Papers, Vol. II, p. 1501.
†The section providing for the origination of money bills by the House.
‡Madison Papers, Vol. II, p. 1267.
§Madison Papers, Vol. III, p. 1270.
||Elliott's Debates, Vol. V, p. 414.

upper house as did Franklin's plan. It was therefore unacceptable to a majority of the states and was stricken out, August 13.* On August 15 still another proposition was made which was intended to win the favor of the small states. This amendment while reserving to the House of Representatives the right of originating money bills, added the concession "but the Senate may propose or concur with amendments as in other cases."† This new proposition for compromise was not brought up for immediate consideration, but was postponed until August 31, and on that date the amendment was referred with several other subjects to a committee of one from each state. On September 4, this committee made a report suggesting that the Senate should be given the exclusive power to ratify treaties, to try all impeachments, and to confirm the appointment of officers, while, as a return for these exclusive powers, the committee reported the following clause; "All bills for raising revenue shall originate in the House of Representatives, and shall be subject to alterations and amendments by the Senate."‡ This proposal seemed to be very nearly what had been at first demanded and at the same time was less objectionable to the small states. On September 8th, the question came up for final consideration, and a speech by Gerry, in which he argued that the plan of the convention would certainly be rejected by the people if the Senate was not restricted from the origination of money bills,§ led finally to the adoption of the proposition in the form in which it is found in Art. I, Sec. 7, of the Constitution, "All bills for raising revenue shall originate in the House of Representatives, but the Senate may propose or concur with amendments as on other bills."|| The discussions of the convention clearly indicate that the provision was not generally regarded as involving an essential constitutional principle. Many considered it the most convenient ground upon which to base a compromise, others thought it necessary for the adoption of the constitution by the people, while there were a few who were either in favor of it because of a firm belief in the principle or were opposed to it because of an equally firm disbelief in the wisdom of such a provision. The spirit of compromise predominated finally and the provision was accepted with but two dissenting votes, Maryland and Delaware.**

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*Elliott's Debates, Vol. V, p. 420.

†Ibid., p. 427.

‡Ibid., p. 509.

§Madison Papers, Vol. III, p. 1309.

||Ibid., p. 1609. This change in wording was made at the last minute and is said to have been derived from the constitution of Massachusetts.

**This is the more remarkable as the two states voting against the provision are the very states whose constitutions previous to 1787 contain stringent provisions in regard to money bills.

The only other provision of the constitution which may be called budgetary is Art. I, Sec. 9: "No money shall be drawn from the Treasury but in consequence of appropriation made by law; and a regular statement and account of the receipts and expenditures of all public moneys shall be published from time to time." This provision was first submitted, in part, in Franklin's report of July 5, and formed a part of his plan of compromise. The wording of the report was, "and that no money shall be drawn from the public treasury but in pursuance of appropriations to be originated in the first branch."* With the change in the wording of the main clause it became necessary to alter the latter clause also, and this having been done it was adopted on September 17, with the addition of the words requiring regular reports.† There was very little discussion upon this provision apart from the debate upon the main question, and the delay in adopting it was due merely to the necessity of first deciding whether or not the House of Representatives was to be given the right of originating money bills.

It was however of very little importance that the majority of the framers of the constitution did not regard the restriction of the origination of money bills to the House of Representatives as a great constitutional principle, for the people did regard it as such, and Gerry was right when he said that the presence or absence of such a provision would have much to do with the acceptance or rejection of the constitution by the people. That this provision has come to be regarded as a constitutional principle is clearly shown by the fact that many of the state constitutions which have been either altered or adopted since 1787, contain sections almost and in many cases exactly similar to Art. I, Sec. 7, of the constitution of the United States.‡ It cannot be said that the principle of the English constitution in this matter was accepted by the constitutional convention and therefore placed in our form of government. But once placed there it was accepted by the people as what they were pleased to call "a self-evident truth," and it has been believed by the American people ever since the adoption of the constitution that the people, through their representatives, should control the extent and purpose of taxation.

*Elliott's Debates, Vol. V, p. 274.

†Madison Papers. Vol. II, p. 1613.

‡An examination of Poore's Charters and Constitutions of the United States, shows that eighteen state constitutions contain a provision restricting the right of originating revenue bills to the lower branch of the legislature.

B.—Debates in Congress on the Interpretation of Constitutional Provisions.

There is hardly a section of the constitution which has not been the subject of very material disagreement as to interpretation, and the budgetary provisions of the constitution are no exception. The discussions over the correct interpretation of these budgetary provisions have usually been carried on by the House of Representatives, and have arisen from the determination on the part of the House to guard jealously its privileges in control of money affairs. These discussions and the decisions reached will indicate the way in which the budgetary provisions of the constitution have been regarded in times past and are regarded today, and it is proposed therefore to consider some of the more important of them.

I. First Congress, 1789. Debate on the clause of the Treasury bill which made it the duty of the Secretary of the Treasury to report a plan for the management of the revenue.

June 4, 1789, a House committee on arrangement of the three executive departments reported a bill for the treasury department.* This bill did not come up for discussion until June 25, when it at once received much hostile criticism upon constitutional grounds because of the wording of the second clause which made it the duty of the Secretary of the Treasury "to digest and report plans for the management of the revenue and the support of the public credit." Those who were opposed to the adoption of this clause argued that it violated the spirit of the constitution in that it tended to lessen the control of the House over money bills. Mr. Page moved to strike out the clause and observed "that it might be well enough to enjoin upon him (the Secretary of the Treasury) the duty of making out and preparing estimates, but to go any further would be a dangerous innovation upon the constitutional privileges of this House; it would create an undue influence within these walls because members might be led, by the deference commonly paid to men of abilities who give an opinion in a case they have thoroughly studied, to support the minister's plan even against their own judgment."† Mr. Tucker followed, stating even more forcibly the constitutional objection as he saw it Referring to the clause mentioned, he said "It will abridge the peculiar privilege of this House for the constitution expressly declares that all bills for raising revenue shall originate in the House of Representatives. * * * In short, Mr. Chairman, I can never

* Annals of Congress, Vol. I, p. 420.
† Ibid., p. 592.

agree to have money bills originated and forced upon this House by a man destitute of legitimate authority, while the constitution gives such power solely to the House of Representatives." *

These objections seem to have taken the House rather by surprise and there were not many representatives prepared to discuss the point. The debate lasted the greater part of the day. Mr. Benson, the first to defend the wording of the clause, declared that "if the proposed amendment prevail the bill will be entirely nugatory. The most important service that can be rendered by a gentleman who is at the head of the department of finance is that of digesting and reporting plans for the improvement of revenue. * * * For my part I am at a loss to see how the privilege of the House is infringed. Can any of the Secretary's plans be called bills? Will they be reported in such a form even?" † In a similar way, Mr. Lawrence argued that any bill "cannot be originated in my opinion until the sense of the House is declared; much less can a plan for the improvement of the revenue be said to be a money bill." ‡

This discussion of the exact meaning of the constitutional question aroused a wider interest when those who were most prominent in discussing Art. I, Sec. 7, in the constitutional convention undertook to interpret it in the halls of Congress. As in the convention Mr. Gerry had been for the exclusive privilege of the House and Mr. Madison opposed to it, so now these two men took opposite sides in the debate. The speech of the former was the strongest argument made against the bill as it stood and in favor of the amendment of Mr. Page. He expressed himself in favor of the object of the clause, that is, to get all the information possible for the purpose of improving the revenue, "but," said he, "do gentlemen consider the importance of the power they give the officer by the clause? Is it not part of our legitimate authority? And does not the constitution expressly declare that the House solely shall exercise the power of originating revenue bills? Now what is meant by reporting plans? It surely includes the idea of originating money bills, that is, a bill for improving the revenue, or in other words, of bringing revenue into the treasury. For, if he is to report plans, they ought to be reported in a proper form and complete. This is giving an indirect voice in legislative business to an executive officer. * * * But if my construction is true, we are giving up the most essential privilege vested in us by the constitution." § In a later speech Mr. Gerry partly confessed that his "construction" might not be entirely logical,

* Annals of Congress, Vol. I, p. 593.
† Ibid., p. 593-94.
‡ Ibid., p. 603.
§ Ibid., p. 601.

nevertheless he insisted on the necessity of carefully guarding the peculiar privilege of the house over money bills. In reply Mr. Madison, who practically closed the debate, said: "I am at a loss to see where the danger lies. These are precisely the words used by the former Congress on two occasions; one in 1783, the other in a subsequent ordinance which established the Revenue Board. The same power was also annexed to the office of Superintendent of Finances, but I never yet heard that any inconvenience or danger was experienced from the regulations. * * * With respect to originating money bills, the House has the sole right to do it; but if the power of reporting plans can be construed to imply the power of originating revenue bills, then the constitution is inconsistent with itself in giving to the President authority to recommend such measures as he may think expedient or necessary; but the construction is too unnatural to require further investigation."* Previous to the speech of Mr. Madison, Mr. Fitzsimmons had moved to substitute "prepare" for "report" so that the clause read "digest and *prepare* plans for the improvement and management of the revenue and the support of the public credit," and this alteration was accepted without much argument.

This debate derives its importance from the fact that it occurred in the first session of Congress, and was the first indication, after the adoption of the constitution, of the emphasis placed by the House upon the privilege of originating revenue bills. There was not a speech during the debate which belittled that privilege or gave evidence that the speaker thought the privilege unwise or unjust. Even Mr. Madison did not at this time express any doubts as to the wisdom of such a privilege. He simply accepted the provision as in existence and therefore to be followed, but he failed to see how the clause of the treasury bill, as originally reported, violated the constitution. The decision reached was of little importance. The real importance of the debate lies in the unanimity of opinion as to the power of the House. Yet there is another point of interest in that, apparently, "money bills" and "revenue bills" meant the same thing in the minds of the speakers. In the argument of Mr. Madison, for example, an illustration of this is given. No attention was called to the possible distinction between the two terms, and it must be supposed therefore, that the House considered itself to have the exclusive initiative in all money matters, whether for increasing the revenue or for decreasing it, or, possibly, for appropriating money. These points will be of interest in connection with the accounts of subsequent disagreements between the House and the Senate.

*Annals of Congress, Vol. I. p. 604-5.

II. 1792—1800. Demand of the House of Representatives for regular reports from the Secretary of the Treasury.

The next question which arose in Congress over the financial provisions of the constitution referred to that clause which provides for "a regular statement and account of receipts and expenditures." This debate indicated a determination on the part of the House to resist the encroachment of other departments of government. The definite steps taken in a succession of years opposing the control of financial matters assumed by the Secretary of the Treasury, were sometimes taken in connection with legislation of an entirely different nature. Thus the extension of the duties of the committee of Ways and Means*, in 1802, was the final step in that direction. There were, however, a series of definite attempts made to compel the Secretary of the Treasury to render regular statements, as provided by the constitution, and this series of demands by the House is now therefore reported.

Art. VII., Sec. 9 of the constitution provides that "a regular statement and account of the receipts and expenditures shall be made from time to time†," but the chaotic condition of financial affairs in the new government was such as to prevent Hamilton from making any regular report, whether he wished to do so or not. Moreover Hamilton was firm in the belief that the power of the executive should be strengthened, so that he was likely to resent any decided interference by the House of Representatives with the financial policy of the Treasury department. As early as 1790, however, the Secretary of the Treasury had been ordered by various resolutions of the House to make reports for specific times, and finally in 1792, a resolution was passed calling for an annual report of the condition of the Treasury. Hamilton professed his inability to make any such report, and attempted to put the question aside by a partial report made on Feb. 4th, 1793. This led to the adoption of the resolution of June 5th, 1794, "that the Secretary of the Treasury lay before the House of Representatives at each annual session within ten days of the commencement of the same a distinct account of the revenues arising under the several duties and taxes, and of the expense attending the collection of each particular duty or tax, as far as such expenses can be discriminated; and also of the number of officers employed in collecting public revenue, and the allowance made to them respectively.‡" This resolution called for a report on the revenue only, but the Secretary of the Treasury was either unwilling or unable to

*See Part C. of this paper, on development of financial committees in House of Representatives.
†Clause 7.
‡House Journal, 1793-97, Vol. II., p. 206.

satisfy the House in this regard. But with the session of 1795 a definite policy was entered upon by the Republicans. They wished to subordinate the power of the executive to that of the House of Representatives *, and an important element in their plan was the giving to the House of Representatives absolute control over financial matters. In this part of the contest Gallatin took the lead †, and it is in large measure due to his efforts that the power of the Secretary of the Treasury was weakened, and the power of the House increased. His first measure was the appointment of a committee to oversee the operation of the Treasury department; a committee ‡ which would be an efficient aid when the Secretary of the Treasury and the House should be agreed as to policy, but which would be a troublesome enemy if such agreement did not exist. The purpose of Gallatin was to establish the expenses of the government upon a permanent footing, and to bring the accounts of the Treasury department into such shape that they could be easily understood and wisely controlled by the House of Representatives. In pursuance of this policy a controversy arose in 1796 over the appropriations for the service of the year, the Federalists claiming that the House had no business to discuss the merits of the establishments for which money had been previously appropriated. Gallatin, on the other hand, argued that the House had power "to appropriate or not to appropriate for any object whatever, whether that object was authorized or not §," and although nothing was decided by this debate, the views of Gallatin were finally accepted. In the second session of 1796, Gallatin complained that the Secretary of the Treasury was of the opinion that he had the right to take money from one appropriation where there was a surplus and apply it to another where there was a deficit. On this account he introduced a rider to an appropriation bill resolving that "the several sums shall be solely applied to the objects for which they are respectively appropriated. ||" This bill passed and was regarded as greatly restricting the powers of the Secretary of the Treasury, but still the contest between the House and the Secretary, on the subject of regular reports, was continued. Finally, after a number of years, a law called supplementary to an act entitled "An act to establish the Treasury department, **" was intro-

*That the main plan underlying this struggle was to place more power in the hands of the House of Representatives, is seen in the controversy over Jay's treaty. Thus Madison said the question was "whether the general power of making treaties supersedes the powers of the House of Representatives, particularly specified in the constitution, so as to give the executive all deliberative will, and leave the House only an executive and a ministerial legislative agency." J. A. Stevens, Life of Gallatin, p. 114.

† Ibid., pp. 109-134.

‡ Committee of Ways and Means. See Part C. of this paper.

§ Stevens, Life of Gallatin, p. 112.

|| Ibid., p. 134.

** Peters, Vol. II., Chap. 58, p. 79.

duced in the Senate, was agreed to by the House, and was signed by the President on May 10th, 1800. It provided that "it shall be the duty of the Secretary of the Treasury to digest, prepare and lay before Congress at the beginning of each session, a report on the subject of finance, containing estimates of the public revenue and the public expenditure, and plans for improving or increasing the revenues, from time to time, for the purpose of giving information to Congress, in adopting modes of raising money requisite to meet the public expenditures.*" By this law it became the duty of the Secretary of the Treasury to furnish a report of the financial condition of the government, upon which the committee of Ways and Means would be able to base its plans for the budget of the year. The law undoubtedly increased the power of Congress over money matters, and this power was still further increased by the creation of a House committee of Ways and Means, with well defined duties and privileges. From this time on, the control of the Secretary of the Treasury grew weaker and weaker, until finally the House, through the committee of Ways and Means, became the sole judge of all kinds of budgetary legislation. Occasionally there was a Secretary who, by superior force of character, so imbued the house with a belief in his ability to manage the finances that his plans were accepted almost without question, but as a general rule the chairman of the Ways and Means committee had far greater influence than the Secretary of the Treasury, in the preparation of financial measures.

The Secretary of the Treasury has, today, a great power over the expenditure of money once that money has been appropriated by Congress, but his ability to direct financial legislation is limited to advice. This limitation was brought about by the action of the House in the years from 1792 to 1800. The House had, then, early recognized the necessity of watchfulness of the executive branch of the government, but had not as yet been brought to fear any attack upon its special privilege from the upper house of the legislature.

III. Twenty-second Congress, 1833. Clay's Tariff Bill. Senate discussion on the question of the right of the Senate to originate revenue bills.

On February 12, 1833, Mr. Clay asked leave to introduce into the Senate a bill "to modify the various acts imposing duties on imports."† The existing tariff law had proven very distasteful to the southern states and also to some Senators from the northern states.

* A peculiar fact in connection with this law is that Gallatin, although heartily sympathising with the purpose of the measure, voted and spoke against it because he considered that the Senate was in this case really originating a money bill and so violating the privilege of the House.

† Cong. Deb., Vol. IX, pt. 1, p. 462.

The bitter antagonism between parties and states, resulting from the clash of selfish interests, seemed to threaten the disruption of the Union and the overthrow of the national government. It was evident that some compromise was necessary by which peace might be restored and prosperity insured, and it was with this purpose in view that the bill to modify the tariff was brought forward. Compromise was the central idea of the framer of the bill, and of a majority of the Senate, so that it is not a matter of surprise that in the long discussion which followed very little was said as to the constitutional right of the Senate to originate revenue bills. Such discussion as did take place was confined largely to the motion for leave to introduce the bill, yet that discussion is of importance inasmuch as it shows the fear which certain senators had of trenching upon the constitutional privilege of the House of Representatives.

In his opening speech, Mr. Clay, referring to the right of the Senate to originate such a bill, said: "I owe, sir, an apology to the Senate for this course of action, because, although strictly parliamentary, it is nevertheless out of the usual course of this body." * The moment he ceased speaking, the point of attack which he had thus suggested was assailed by Mr. Forsythe, who, while he admitted that the main purpose of the bill was in every way worthy of approval, said that besides having minor faults, "the bill was a violation of the constitution, because the Senate had no power to raise revenue and that he opposed the introduction of the bill as a revenue measure, and upon it demanded the yeas and nays." † This objection precipitated a protracted debate in which many senators took part, although no speech was confined exclusively to the constitutional question. In reply to Mr. Forsythe's objections, Mr. Poindexter said, "As to the constitutional point, the only violation of the rule prohibiting the Senate from originating a bill raising revenue would take place at the consummation, not at the inception of the measure." ‡ This was certainly a curious interpretation, and, whether correct or not, was an injudicious one, inasmuch as it would be foolish for the Senate to discuss at length any bill which it had no right to pass. Mr. Clay made a new point, however, in replying to Mr. Forsythe. He called the attention of the Senate to the fact that "the bill was not a bill to raise duties, but to reduce them, and therefore did not come within the reach of an equitable objection. If it had been a bill to raise the rate of duties the objection to it would have been a valid one. * * * The constitution says that all bills to raise revenue shall

* Cong. Deb., Vol. IX. pt. I. p. 462.
† Ibid., p. 473.
‡ Ibid., p. 474.

originate in the House of Representatives. This was a bill to reduce the duties, except in a single clause, and that clause relates to the act, which had not yet gone into operation. * * * He did not believe that it was the intention of the constitution so far to restrict the right of the senate as to preclude the origination of a bill to repeal an existing law."* Probably this was the first important occasion upon which a distinction between raising revenue and reducing revenue was made. This point became the point in controversy between House and Senate at a later day, but at this time the House had no opportunity to discuss the queston. Mr. Dickerson disagreed with Mr. Clay's interpretation of the constitution: "Such a bill as this could not originate in the senate. * * * To raise revenue was entirely a distinct thing from a mere question of the modification of duties. The term as used in the constitution implies the collecting and bringing money into the treasury."† Mr. Webster stated in reply that "by its title the bill could hardly be rejected as a bill for raising revenue, which ought to originate in the other House,"‡ and that he should vote for the leave to introduce it. His position at this time is possibly, and yet not necessarily, at variance with his later speech against the entire bill.

Mr. Clay's assertion that the bill proposed to reduce and not to raise revenue and that it did not, therefore, come under the constitutional restriction upon the Senate, satisfied most of those who had previously opposed its introduction. Mr. Dickerson was not satisfied, but Mr. Forsythe now altered his argument and stated that while he could not see any constitutional objection to Senatorial action upon a bill to reduce the revenue, yet the one clause which Mr. Clay had admitted was intended to raise duties was sufficient to cause his original objection to hold good. He therefore moved to strike out that clause.§ The Senate, however, refused to alter the bill, and leave was given to introduce it.‖

At the time when Mr. Clay's tariff bill was introduced the Senate was engaged in the consideration of the revenue collection bill, so that it was not until February 19 that the tariff bill was reported back** from the special committee to which it had been sent. On February 21 it was made a special order.†† Meanwhile a tariff bill, not at all similar to Mr. Clay's, had been introduced in the House,

*Cong. Deb., Vol. IX, pt. I, p. 477.
† Ibid., p. 478.
‡ Ibid., p. 478.
§ Ibid., p. 480.
‖ Ibid., p. 481.
** Ibid., p. 601.
†† Ibid., p. 690.

and had been vigorously discussed with little probability of being passed before the end of the session. When the Senate bill became a special order but seven business days of the session were left. Under these circumstances the constitutional point was barely touched upon in the first part of the debate, and did not come up again until the closing arguments were made. A point of curious interest which did, however, arise early in the debate, is the changed attitude of Mr. Forsythe, who had first objected to the whole bill as unconstitutional and afterwards had restricted his objection to the one clause of the bill which provided for the raising of duties. He next declared himself in favor of the passage of the entire bill, objectionable clause included, on the ground that since the bill was introduced and "having originated in the Senate notwithstanding the constitution, he could perceive no prohibition against its passage." *

The main argument against the constitutionality of the bill was that made by Mr. Webster. His argument was: "The constitutional question must be regarded as important; but it was one which could not be settled by the Senate: it was purely a question of privilege and the decision of it belonged alone to the House. The Senate by the constitution could not originate bills for raising revenue. It was of no consequence whether the rate of duty was increased or decreased; if it was a money bill it belonged to the House to originate it. This subject belonged exclusively to the House of Representatives." † In reply Mr. Clay reiterated his statement that the bill "might be constitutionally passed by the Senate, because it was not a bill for raising revenue," ‡ yet several senators now affirmed that they could not vote for the bill because it had originated in the Senate. It is probable that a majority vote could have been secured for the measure in spite of these objections, but its passage was regarded as doubtful by Mr. Clay, and a plan was at once prepared by which the danger of defeat might be lessened. On February 26, after the House tariff bill had been debated some three weeks, a motion § was made to amend that bill by striking out all but the enacting clause, and substituting the Senate bill. In spite of angry comment on the part of the opposition this was done, and the bill as amended was rushed through the House and sent to the Senate, February 27. ‖ The Senate, being assured by Mr. Clay that the House bill was identical with his own, laid both bills upon the table and then took up for consideration the House bill. This silenced all opposition on the ground of unconsti-

* Cong. Deb., Vol. IX, pt. I. p. 719.
† Ibid., p. 722.
‡ Ibid., p. 723.
§ Ibid., pt. II, p. 1772.
‖ Ibid., pt. I, p. 785.

tutionality. All that Mr. Clay said in favoring the acceptance of the House bill was that "it would obviate the reasons for a longer continuance of a laborious day's session of this body, and also supersede the objections of some Senators who believed the Senate was not the proper place for the origin of this bill." * March 1st the House bill was passed by the Senate.†

The most important feature of the debates in this Congress upon the power of the Senate to originate the tariff measure is that a majority of the members of the Senate did not think that the restriction in favor of the House applied to the case in hand. For that majority the argument of Mr. Clay was sufficient, namely that the bill was not specifically a bill to raise revenue. The main reason why the bill was not pressed in the Senate was a fear on the part of its author that it might be defeated at the last moment by some of those who were opposed to it on grounds of unconstitutionality solely. It was the better plan to deprive these gentlemen of their excuse for voting against the bill. The fact that the Senate bill was withdrawn and the House bill substituted was a fortunate outcome of the difficulty, but it was not regarded as a precedent by later Senates. The House had made no objection to the Senate's action because that action had not come before it for consideration. The Senate had merely made a concession to some few of its own members. The question of its right to originate revenue bills was not settled, and the method by which it might claim the right by making a distinction between raising revenue and reducing revenue had now been indicated and was later to occasion a breach between the two branches of Congress. In one other way also the debate had outlined the only method by which this question could be settled. Mr. Webster had correctly interpreted the situation when he said it was purely a question of privilege, and the decision of it belonged alone to the House. When the House should once decide the extent of its privilege the Senate would be compelled to acquiesce in that decision.

IV. Twenty-fifth Congress, 1837. Debate in the House on the Senate bill to authorize the issue of Treasury notes.

September 13, 1837, a bill‡ was reported to the Senate, authorizing the issue of Treasury notes for certain purposes. In the discussion of this bill in the Senate, the possible impropriety of its originating there was not mentioned, and on September 18 the bill was passed § and sent to the House. September 30, in committee of

* Cong. Deb., Vol. IX, pt. I, pp. 749-50.
† Ibid., p. 809.
‡ Ibid., Vol. XIV., pt. I, p. 9.
§ Ibid., p. 75.

the whole, the House took up the bill,* and a brief discussion at once ensued as to the right of the Senate to originate such a measure. Mr. Bell, of Tennessee, was the first to suggest the unconstitutionality of the bill, and was followed by Mr. Adams, of Massachusetts, who said "that in his opinion the matter admitted of no question at all. If there ever was a money bill this was one. * * * This House had too long suffered the other branch of the legislature to dictate to it every measure relating to the revenues.†" Mr. Robertson, of Virginia, argued in the same line. Mr. Cambreling, of New York, chairman of the Ways and Means committee, saw no real objection to the bill on the ground that it had originated in the Senate, but in order to prevent further opposition, moved to take up the House bill on the same subject. This was done ‡, and the House bill sent to the Senate and passed by that body.

The debate attracted little attention, and is of interest merely as the first objection by the House to the reception of Senate bills indirectly bearing on the revenue. In the case of the Clay compromise bill, the House had itself taken no part in the discussion, although its action had relieved the Senate of the fear of violating the constitution. In this instance the House established a precedent, and indicated a sense of its own privilege.

V. Twenty-eighth Congress, 1843-44. Debate in the Senate upon tariff bill introduced by Mr. McDuffee, of South Carolina.

December 19, 1843, a bill was introduced § in the Senate by Mr. McDuffee, of South Carolina, providing for a return to the Clay compromise tariff of 1833. The bill was referred to the committee on finance notwithstanding the objection made by Mr. King ‖ that the Senate had no right to originate it, and on January 9, 1844, was reported back by Mr. Evans ** with the following resolution against its consideration: "Resolved, that the bill entitled 'a bill to revive the act of the 2nd of March, 1833, usually called the compromise act, and to modify the existing duties upon foreign imports in conformity with its provisions' is a bill for raising revenue within the meaning of the 7th section of the 1st article of the constitution, and cannot therefore originate in the Senate; therefore resolved, that it be indefinitely postponed." ††

The reason for this action was the desire of a majority of the the Senators to avoid a discussion of the tariff question. Some, no

* Cong. Deb., Vol. XIV., pt. I, p. 1152.
† Ibid., p. 1152.
‡ Ibid., p. 1153.
§ Cong. Globe, I. Sess. 28 Cong., p. 47.
‖ Ibid., p. 47.
** Ibid., p. 121.
†† Ibid., p. 121.

doubt, honestly favored the resolution on constitutional grounds, and in the final vote but four Senators voted against the constitutional doctrine expressed therein. It was on the constitutional question, however, that the debate was begun. Mr. Evans opened the discussion on January 18, and his argument practically embraced all that was urged against the constitutionality of the bill. He asserted that "the whole question turned upon the meaning of the words 'raising revenue.' In the present instance but one meaning could be received, in as much as the avowed object of the framer of the bill was, by reduction of the duties of importation, to increase the revenue by thus creating a greater demand. It might be argued that it is not a bill for raising revenue, but to reduce duties, 'duties' being equivalent to the word revenue. This argument * * * is not substantial. * * And if admitted that the reduction of duties sought for by this bill will, by enlarging our commerce and holding out a bonus to our merchants and ship owners to increase their traffic, add to that revenue, then the question is at once set at rest, and the Senate has no power to originate such a measure.*" Thus accepting the definition of the word "raise" as opposed to "reduce," Mr. Evans still objected to the introduction of this bill. He had previously asserted that the sole object of the committee in reporting the resolution was to obtain the opinion of the Senate in regard to the right of origination, and it followed that the committee desired to prevent the Senate from discussing the tariff itself. The Chair, however, decided † that the entire subject matter of the bill was open for discussion, and under this ruling little attention was paid to the constitutional objection, although the debate was renewed nearly every day from January 19 to May 31. In the beginning it was confined largely to the substance of the resolution, and Mr. Huntington went even further than Mr. Evans, saying that there was "an important distinction between the general meaning of the words to *raise* revenue, and the particular meaning of the word *raise* as applied to the increase of anything. To raise revenue signified to *provide* an income, now generally applied to an income for government.‡" On the other hand Mr. Woodbury did not believe that there was any constitutional restriction in the case before the Senate: "The only limitation with regard to the Senate was in regard to bills for imposing taxation for revenue, and then the origin of such bills must be in the other House. It is only the imposition of a new tax, or duty, or the increasing of duties already existing, that the Senate is pro-

*Cong. Globe., I. Sess. 28 Cong., p. 159.
†Ibid., p. 159.
‡Ibid., p. 161.

hibited from originating."* In like manner Mr. McDuffee emphasized the plea offered in 1833, that this was a bill to reduce duties.†

Very few of the Senators even mentioned the constitutional phase of the bill. The debate was almost wholly on the tariff, although once Mr. Berrien brought the Senate back to a consideration of the resolution *per se*, remarking that "however important might be the discussion of the merits of the bill, there stood in advance of it a question far more important, which was, whether the Senate of the United States would confine its legislation within the limits of the constitution, or usurp a power which the constitution had not conferred upon it.‡" In general, however, the debate progressed with no reference to this point, and as it drew to a close, it became manifest that the bill would have no chance of passing, even if it should come before the Senate for a direct vote. Consequently it was not at first intended to permit a vote of the Senate which would show just how each member stood with regard to the matter of Mr. McDuffee's bill. But if a vote was to be demanded upon the resolution alone, many Senators who really favored the tariff bill would find it necessary to vote for the resolution preventing the introduction of that bill. Senators were afraid that their votes would not be understood. Further, a vote on the resolution alone, would appear to be a device for the shirking of responsibility for a vote on tariff reduction. Hence Mr. Allen introduced an amendment to the resolution, reading: "Resolved that the duties imposed on importations by existing laws are unjust and oppressive, and ought to be repealed, but that the bill,§" etc. On this amendment the vote stood yeas, 18; nays, 25, indicating each Senator's position on the tariff, while on the resolution itself the vote§ was yeas, 33; nays, 4.

This overwhelming vote was another step in preserving to the House the right of originating money bills. As yet, however, the Senate had put no interpretation on the words "for raising revenue."

VI. Thirty-fourth Congress, 1855. Debate in the Senate upon the attempt of the Senate to originate general appropriation bills.

December 11th, 1855, Mr. Brodhead of Pennsylvania introduced into the Senate a resolution,** "that the committee on finance be directed to inquire into the expediency of reporting the appropriation

*Cong. Globe, I. Sess. 28 Cong., p. 160.

†Ibid., p. 165.

‡Ibid., p. 493.

§Ibid., p. 633.

‖Ibid., p. 633.

**Cong. Globe, 1855-56. pt. I, p. 160.

bills for the support of the government, or of adopting other measures with a view of obtaining more speedy action on said bills." The resolution was adopted on January 7th, 1856. Mr. Brodhead urged in its favor: first, that the House is accustomed to retain the general appropriation bills for about two hundred days, on the average, leaving the Senate only ten days in which to consider such bills; second, that such procedure is practically denying to the Senate its constitutional right of consideration; third, that the Senate possesses the power of originating appropriation bills, for the constitutional provision reads "All bills for raising revenue," whereas the original proposition in the federal convention was definitely extended to appropriating money also, and that since mention of this power was omitted afterwards it was evidently the intention of the framers of the constitution to leave it with the Senate;* fourth, that the Senate already exercises the power in bills which render necessary the expenditure of money. The resolution aroused little discussion at the time it was voted upon. When introduced there seemed to be some excuse for it as the House was undergoing a protracted contest over the election of Speaker, so that public business was greatly delayed. But when the finance committee, on February 4th, 1856, introduced a resolution in accord with Mr. Brodhead's proposal, some members were strongly opposed to the innovation. The resolution provided: "That the committee on finance be instructed to prepare and report such of the general appropriation bills as they may deem expedient."†

Mr. Seward of New York stated the principal objection to the resolution, and as this was the first occasion upon which the Senate debated its right to originate a general appropriation bill, the essential portions of his argument are given at length. "The government," he said, "has been in operation since the year 1789, a period of more than half a century, and never yet has a general appropriation bill been prepared, or reported or submitted to the Senate, or sent to the House of Representatives from this body. On the other hand the practice has been that all appropriation bills of that character have originated in the House of Representatives and have been sent to this house for its concurrence and amendment. As this, then, is a proposition, made not only for the first time within our own experience, but for the first time since the foundation of the government, we are to presume that it will be admitted that what is proposed is an innovation, a direct, specific and effective innovation. * * * I am not going to contend that the provision of the constitution, which I have

*See Elliot's Debates, Vol. I, p. 206.

†Cong. Globe, 1855-56, pt. I, p. 375.

read, by its letter forbids the Senate from originating appropriation bills; its letter clearly concedes it, and I concede also that there is an argument to be drawn from the fact that the convention discussed the proposition in both its shapes, and finally adopted the one which we now find, in which the limitation is applied only to bills originating revenue, that the convention may have considered that appropriation bills might be originated in the Senate. But against this argument is one which seems to me perfectly conclusive, and it is this reply: Whatever the convention may have purposed * * * the fact is a stubborn one, that the Senate has never originated an appropriation bill, but that it has always conceded to the House of Representatives the origination of appropriation bills: and the House of Representatives has never conceded to the Senate the right to originate such bills, but has always insisted upon and exacted that right itself. This could not have been accidental; it was therefore designed. The design and purpose were those of the contemporaries of the constitution themselves, and it evinces their understanding of the subject, which was that bills of a general nature for appropriating public money, or for laying taxes or burdens on the people, direct or indirect in their operation, belonged to the province of the House of Representatives."* Mr. Seward also pointed out that even if the Senate did adopt the resolution, it would be impossible for the finance committee to follow directions with success unless, what was highly improbable, the House of Representatives should give its consent. The argument of Mr. Seward includes about all of the points made against the resolution. The only new argument in its support was the peculiar one offered by Mr. Hunter,† that as the membership of the House increased bills would be more liable to be detained there, so that the supreme power would be likely to pass into the hands of the Executive, and that for this reason the Senate should originate appropriation bills, in order that the legislature might retain its accustomed power.

Both sides, however, seemed afraid to touch upon the real question at issue, whether the Senate should be allowed to increase its power at a time when the Senate and the House were on the point of differing as to the policy of the government. The great question of the day was with regard to the Nebraska-Kansas trouble. A very slight majority of the House was in favor of the Free Soil party in Kansas, while a large majority in the Senate favored the slavery party. The desire of the Senate to originate appropriation bills was looked upon as an attempt on the part of the friends of the South to compensate

*Cong. Globe, 1855-56, pt. I, pp. 875-6.
†Ibid., pp. 877-8.

themselves for a loss of influence in the House. Although none of the speeches boldly stated this to be the real question at issue, yet various members of the minority, broadly hinted that they understood perfectly the plan of their political opponents. Mr. Sumner* said: "Mr. President, it is a received maxim that it is the part of a good judge to amplify his jurisdiction; but it will hardly be accepted that it is the part of the American Senate to amplify its powers, particularly in derogation of the popular branch. And it surely cannot escape observation that the present effort is launched at a moment when the popular branch promises to differ from the Senate on important questions of national policy." In the same vein Mr. Wilson† said: "Now Sir, we are called upon at this time to depart from that practice, and permit me to say that the time is not well chosen. The public voice of the country will say that, at this juncture, in the peculiar position of affairs in the House of Representatives and in the country, the Senate of the United States is extending its powers and its influence in the government of the country at the expense of the popular branch of the government."

In spite of the persistent opposition of a compact minority, the the resolution was passed. But although the Senate might resolve that it had the constitutional right to originate appropriation bills, it soon found that Mr. Seward was right when he said that such a resolution would be useless if the House should refuse to comply with its demands. In accordance with the resolution the committee prepared general appropriation bills on the subjects of invalid pensions and the repairs of fortifications. Both these bills passed the Senate and were sent to the House, but were laid upon the table by that body without being referred to any committee, and without debate, April 17, 1856. This was the method by which the House indicated that it had no intention of permitting the Senate to usurp its powers. Thus was established a principle which it is not at all certain was intended by the framers of the constitution. One definite attempt upon the part of the Senate to secure the privilege claimed was practically all that was necessary to settle this question; while in the case of the definite provision of the constitution there had already been several debates and there was yet to be discussion as to the exact meaning of a word.

*Cong. Globe, 1855-56, pt. I, p. 380.
†Ibid., p. 381

VII. Thirty-fifth Congress, 1859. House objects to Senate amendment to Postoffice Appropriation Bill. Bill and substitutes offered fail to pass.

During the latter part of the second session of the thirty-fifth Congress a postoffice appropriation bill, involving about $7,000,000, passed the House. The Senate, having added an amendment changing somewhat the rates of postage and in some cases increasing them, passed the bill and returned it to the House March 1, but two days before the close of the session.* No debate seems to have arisen in the Senate over the constitutional privilege of the House to raise revenue, although the House and Senate had already in this session been in controversy over a Senate amendment to a House appropriation bill, by which the sum to be appropriated had been increased. When, however, the amended postoffice bill was received in the House, attention was directed to the nature of the amendment, and on March 2 Mr. Grow, of Pennsylvania, acting upon an arrangement with the chairman of the Ways and Means committee, Mr. Phelps, offered a resolution reading, "Resolved, that House bill No. 872, making appropriations for defraying the expenses of the postoffice department for the year ending the 30th of June, 1860, with the Senate amendments thereto, be returned to the Senate, as the thirteenth section of said amendments is in the nature of a revenue bill."‡ The next day the resolution came up for consideration,§ but at that date there was not time to debate it at length. Mr. Phelps made the only important statement against its adoption, while Mr. Grow gave the only argument in its favor. Mr. Grow said "I do not rise to argue the question, but merely to state my point. This thirteenth section proposes to increase the present rates of postage to five cents and in some cases to ten cents; which would increase the taxation on those who use the mails."|| Mr. Phelps in reply said the amendment did not come within the meaning of the constitutional restriction,** but after some hesitation agreed to permit a vote upon the resolution and it was adopted by a vote of 117 to 76. It is not likely that the House, in this instance, realized that a great constitutional privilege was in danger. Some members were undoubtedly in earnest in maintaining the privilege of the House; others may have wished to delay the bill until the close of the session and by thus preventing its passage to embarrass the President, for House and President were not in harmony; others may have desired revenge for

* Cong. Globe, 1858-59, p. 1520.
‡ Ibid., p. 1600.
§ Ibid., p. 1666.
|| Ibid., p. 1666.
** Ibid., p. 1666.

a recent humiliation in having been compelled to pass a Senate amendment to the general appropriation bill on the issue of treasury notes. No one reason would have sufficed to secure a majority for the resolution. In any case there can be no doubt that many who voted for it expected either that the Senate would recall the obnoxious amendment or that a new postoffice bill would be rushed through in the closing hours.

The resolution and bill were at once sent to the Senate and the resolution was read to that body.* Without debate Mr. Crittenden, by unanimous consent, reported the following resolution, which was agreed to by the Senate: "Resolved, that the Senate and House being of right equally competent, each to judge of the propriety and constitutionality of its own action, the Senate has exercised said right in its action on the amendments sent to the House, leaving to the House its right to adopt or reject each of said amendments at its pleasure: Resolved that this resolution be communicated to the House of Representatives, and that the bill and amendments aforesaid be transmitted therewith."† By this move the Senate evidently thought to throw the responsibility for the failure of the bill upon the House. In still another way perhaps the Senate might virtually be the victor in the contest, in case the house should withdraw its constitutional objection and ask for a conference committee on the question of advisability merely.

The House received the resolution of the Senate‡ and was ready with a new method of attack, which, however left the constitutional question in suspense. Mr. Phelps, from the committee of Ways and Means, reported a new postoffice bill which was read a first and second time, ordered to be engrossed, read a third time, and passed without debate.§ Then the bill was sent to the Senate. This was the same bill as that originally sent from the House, and brought the Senate to face a double difficulty inasmuch as it was without the many Senate amendments, and the responsibility for failure to pass could not but fall on the upper House. The bill reached the Senate at half-past twelve o'clock,|| and those Senators who were most earnest in their endeavors to secure its passage, or the passage of some postoffice appropriation bill, quickly concluded that the course of the Senate must be modified somewhat. Mr. Stuart moved the appointment of a conference committee. This was a favorable opportunity for interference on the part of those Senators who did not

* Cong. Globe, 1858-59, p. 1634.

† Ibid., p. 1634.

‡ Ibid., p. 1674.

§ Ibid., p. 1674.

|| Ibid., p. 1643.

wish any postoffice bill to pass, and technical objection was at once made that there was as yet no disagreement between the Senate and the House. Finally, however, the conference committee was appointed,* composed of Messrs. Stuart, Pearce and Foot. The House at once responded by the appointment of a like committee,† composed of Mr. Letcher, Mr. Branch, and Mr. Grow, although several members objected to the appointment of the committee. The report of this committee was unanimous, and the resolution reported was "that while neither House is understood to waive any constitutional right, which they may respectively consider to belong to them, it be recommended to the House to pass the accompanying bill, and that the Senate concur in the same when it shall be sent to them." ‡ This third bill merely provided for the necessary expense of the postoffice department, yet was in the main the original bill of the House. It was passed§ by the House without material objection, but when it reached the Senate just one hour before the expiration of the session, Mr. Toombs|| announced that he considered the action of the Senate members of the conference committee as a complete betrayal of the rights of the Senate, and that he should object to the consideration of the bill. In this determination he was supported by many others, so that finally while he was making a speech ** defending his position, the Vice-President interrupted him in order to declare the Senate adjourned *sine die*.

The bill, therefore, had failed to pass in any form, and Mr. Douglass†† may have been right in thinking that the Senate was refusing to consider a necessary appropriation, because of an overestimation of its own dignity. The passage or non-passage of the bill, however, does not present the main point of interest in this study, for the resolution introduced by Mr. Grow is after all the essential thing to consider. All that can be said in regard to it, however, is that the House asserted its privilege and refused to yield to the browbeating of the Senate. This contest between the two Houses was like many others, yet it derives a peculiar interest from the troublous times in which it occurred, and from the rapidity with which one move followed another, for with the exception of the introduction of the Grow resolution, March 2, all that passed between the two Houses occurred on March 3, the last day of this session of Congress.

*Cong. Globe, 1858-59, p. 1646.
†Ibid., p. 1682.
‡Ibid., p. 1661, and pp. 1683-4.
§Ibid., p. 1684.
||Ibid., p. 1662.
**Ibid., p. 1663.
††Ibid., p. 1663.

VIII. Forty-first Congress, 1871. Debate in Senate and in House over a bill introduced in the Senate to reduce the income tax.

December 6, 1870, Mr. Scott introduced in the Senate a bill to repeal so much of the act of July 14, 1870, dealing with internal taxes, as continued the income tax after December 31, 1869.* The bill was referred† to the committee on Finance December 8, and was reported adversely‡ December 16, but was placed upon the calendar by the advice of Mr. Sherman. By vote of the Senate, the bill was made a special order§ for January 25, 1871, and on that day Mr. Scott made a long speech in its favor, but did not once mention the possibility that the bill might be rejected by the House on constitutional grounds. Many Senators spoke, but no one hinted that the Senate had not the right of origination, and on January 26 the bill passed || the Senate by a vote of 26 to 25.

The House received** the bill January 27. Shortly after the message from the upper house had been read, Mr. Hooper, of Massachusetts, arose to a question of privilege and presented the following resolution, "that the Senate bill No. 1083 be returned to that body with the respectful suggestion on the part of the House that section VII., article I. of the constitution vests in the House of Representatives the sole power to originate such measures."†† Mr. Randall objected that this was not a question of privilege, but was overruled by the Chair, who referred to the action of the House in the Thirty-fifth Congress, in the case of the postoffice appropriation bill. The previous question was ordered and the resolution adopted,‡‡ so that no debate whatever occurred at this stage of the proceedings. The bill and resolution were returned §§ to the Senate January 30, where, under the rules of the Senate, they would come up for consideration the next morning.

The next day Mr. Scott |||| moved that the Senate ask for a conference committee, and gave for his reason the usual argument that the bill was one to reduce and not to raise revenue. He also noted that the Senate had certainly been in the habit of originating bills which involved the raising or the spending of money, and that if the House was correct in its position, then "the Senate must stop introducing

* Cong. Globe, 1870-71, pt. I. p. 18.
† Ibid., p. 40.
‡ Ibid., p. 143.
§ Ibid., p. 720.
|| Ibid., p. 755.
** Ibid., p. 790.
†† Ibid., p. 791.
‡‡ Ibid., p. 791.
§§ Ibid., p. 815.
|||| Ibid., pt. II. pp. 843-45.

bills for the payment of private claims, must stop introducing subsidy bills to steamship lines or railroads, must stop creating offices, ordering forts or arsenals to be built, or anything of that kind." * Mr. Sherman asked that the conference committee be granted without debate, as there was other important business to be transacted. However Mr. Williams even went beyond the House resolution, and declared that not only was the origination of all revenue bills to be confined to the House, but that the only amendments which the Senate could rightfully make were amendments strictly germane † to the subject matter of any revenue bill. In regard to the bill under consideration, he said: "Now, sir, what is the difference between originating a system of internal revenue, and originating a bill which shall change and modify and entirely revolutionize that system," ‡ and in conclusion defined his position by stating that "whenever any proposition is made substantially affecting the revenues of the country one way or the other, changing, modifying, increasing, or reducing the revenue system, such a bill ought to originate in the House of Representatives, and be subject to amendment in the Senate." § Mr. Williams agreed, however, to the appointment of a conference ‖ committee, and Mr. Scott, Mr. Conkling, and Mr. Casserly were named. On the same day the House agreed to a conference, and Mr. Hooper, Mr. Allison, and Mr. Voorhees were appointed. **

No agreement was reached by this committee, each side reporting resolutions maintaining the position previously taken. The House committee made its report †† February 27, but the report was not at once considered. The Senate committee made a report ‡‡ March 2. The report defined at great length the Senate's idea of the constitutional restriction, and the main points will be enumerated or quoted here. The history of the principle of restricting the origination of money bills to the lower branch is followed from the British constitution to that of the United States, but attention is called to the distinction made in the constitutional convention between appropriation and revenue, and between money bills and revenue bills. To substantiate these statements letters of Gouvenor Morris are referred to, and it is also noted that George Mason, who wished to give the House exclusive control over *money* bills, refused to sign the draft of the constitution because the Senate was given the power to amend.

* Cong. Globe, 1770-71, pt. II, p. 841.
† Ibid., p. 845.
‡ Ibid., p. 845.
§ Ibid., p. 846.
‖ Ibid., p. 846.
** Ibid., p. 851.
†† Ibid., pt. III., p. 1717.
‡‡ Ibid., p. 1873.

For these reasons it is asserted that the Senate has the constitutional right "first, to originate appropriation bills; second, to originate bills for fixing the salaries of the officers of the government; and third, that money may be drawn from the Treasury upon appropriations which do not originate in the House of Representatives."* In support of these conclusions, history is appealed to and sixteen laws originating in the Senate and passed by the House are enumerated, which involve either an increase in revenue, a reduction of revenue, or the expenditure of money. Writers recognized as authorities on constitutional interpretation are cited as upholding the Senate's position, and finally the committee maintained "that according to the true intent and meaning of the seventh section of the first article of the constitution, 'bills for raising revenue' are those bills only the direct purpose of which is to raise revenue by laying and collecting taxes, duties, imposts, or excises, and that a bill may originate in the Senate to repeal a law or a portion of a law which imposes taxes, duties, imposts, or excises."†

The report of the committee was never debated in the Senate, nor was there any definite motion of adherence, yet it undoubtedly expressed the opinion of a majority of Senators, and is by far the most important statement of the Senate position in the matter, though it by no means follows that a majority of the Senate would ever insist upon pressing this interpretation against the expressed will of the House. In the House the report of the conference committee came up for discussion ‡ March 3, a day after the report made in the Senate. The resolution of the House committee was "that this House maintains that it is its sole and exclusive privilege to originate all bills directly affecting the revenue, whether such bills be for the imposition, reduction, or repeal of taxes; and in the exercise of this privilege, in the first instance, to limit and appoint the ends, purposes, considerations, and limitations of such bills, whether relating to the matter, manner, measure, or time of their introduction, subject to the right of the Senate to 'propose and concur with amendments as on other bills.'" § This brief resolution was the most comprehensive presentation yet made of the position of the House, and forms, together with the resolution on Senate amendments in the succeeding Congress, the best statement of the determination of the House to guard its privilege. There was no protracted debate upon the resolution. Mr. Butler, referring to the bill which had aroused the first discussion, voiced the sentiments of nearly the whole House

*Cong. Globe, 1870-71. pt. III, p. 1874.
†Ibid., p. 1873
‡Ibid., p. 1928.
§Ibid., p. 1928.

in stating that "cutting off one tax is in fact always equivalent in contemplation of law, to raising another."* Mr. Garfield, Mr. Logan, Mr. Hooper, Mr. Allison, and Mr. Lawrence made brief speeches on the necessity of guarding the privilege of the House, and Mr. Garfield asked and secured leave to print a statement† which was intended as an answer to the long report of the Senate committee. Without division the House agreed ‡ to the report and thus took one more step in establishing its control over revenue.

In this debate between Sen ate and House party politics had no place, for the leaders in each house were members of the same political party. This then was a question solely between the two houses as such, and it is undoubtedly for this reason that so much care was taken to substantiate statements and that the statements of privilege were made so broadly. The House defended its privilege and in doing so attacked the custom of the Senate. The essence of the whole matter is to be found in a speech by Mr. Wood in the House on March 3. He said: "The time has arrived when the popular branch of the government of this country must maintain its authority, when the power centered in the Executive, when the power centered in the higher branch of Congress, which represents a very small minority of the American people, shall yield up the prerogative which belongs to this body." § In this developing assurance of the House, in its determination to control legislation, lies the secret of the earnestness with which it conducted the contest. The House had adopted a resolution which stood as a warning to future Senates, and but one more step was necessary to assume absolute control of money matters of whatever nature; and in the next Congress that step was taken.

IX. Forty-second Congress, 1871-72. Contest between House and Senate on attempt of Senate to make amendment to House bill to repeal duties on tea and coffee.

In the second session of the 42 Congress, February 14, 1872, a bill was reported|| to the House by the committee of Ways and Means, to repeal the existing duties on tea and coffee. The committee was opposed to the bill, but had been instructed by the House to report it, and February 19 it was passed** by a large majority. The question of the day, which was interesting both houses, was tariff reduction. The surplus for the ensuing year had been estimated all the

*Cong. Globe, 1870-71, pt. III, p. 1928.
†Ibid., pt. III, Appendix, pp. 264-8.
‡Ibid., pt. III, p. 1930.
§Ibid., p. 1928.
||Cong. Globe, 1871-72, pt. II, p. 1019.
**Ibid., p. 1118.

way from eighty to one hundred million dollars, and both houses were preparing bills for a general reduction. The committee of Ways and Means had thought that the question of a reduction of duties on tea and coffee might very well be left for consideration in the general tariff bill, but the House ordered otherwise.

When the bill reached the Senate it was referred* to the Finance committee and was reported† adversely March 15 and indefinitely postponed, but was taken up‡ March 26 upon the motion of Mr. Scott. No sooner was the bill before the Senate for consideration than one Senator after another moved to amend by adding some article to the free list, and it became evident that it was the purpose of the Senate to make this two line bill of the House the basis of a general tariff bill. While these amendments were being proposed no mention was made of the right of origination of the House, or of the fact that a bill so materially amended had practically originated in the Senate. Mr. Scott now offered an amendment to the tea and coffee bill which practically covered the same ground as his bill of the previous Congress which the House had refused to pass. The objection was made by Mr. Sherman§ that it would certainly be distasteful to the House and would possibly bring about another controversy over constitutional privileges. Mr. Sherman had already stated that in his opinion the Senate certainly had the right to amend the bill under discussion by repealing the internal tax,‖ but that he knew it to be the opinion of the House that an amendment must be germane** to the subject matter. Mr. Edmunds and Mr. Conkling believed that the Senate had the right to amend in any way,†† but nearly all debate turned upon the advisability of the repeal of the tax, rather than upon the right of the Senate to make the amendment, and the bill passed, March 28, by a vote of 35 to 4, though Mr. Scott's amendment had but 28 yeas to 11 nays.‡‡

Mr. Sherman said that he believed Mr. Scott's amendment had been made to defeat the bill.§§ Certainly the House could not be blamed if it should view with suspicion a bill which had grown in the Senate from two lines to twenty pages, and whose very title had been changed. Soon after the bill was sent back to the House, Mr. Dawes, April 2, submitted a resolution "That the substitution by the Senate,

*Cong Globe. 1871-72, pt. II, p. 1126.
†Ibid., p. 1700.
‡Ibid., pt. III, p. 1967.
§Ibid., p. 2037.
‖Ibid., p. 1977.
**Ibid., p. 2040.
††Ibid., p. 2040.
‡‡Ibid., pt. III, p. 2044.
§§Ibid., p. 2044.

under the form of an amendment, for the bill of the House (H. R. No. 1537) entitled 'An act to repeal existing duties on tea and coffee,' of a bill entitled 'An act to reduce existing taxes,' * * * is in conflict with the true intent and purpose of that clause of the constitution which requires that 'all bills for raising revenue shall originate in the House of Representatives,' and that therefore said substitute for House bill No. 1537 do lie upon the table."* The clerk of the House was also directed to inform the Senate of the purport of the resolution if the House should see fit to adopt it. The debate which ensued was all upon one side, and the names which follow indicate that the best talent of the House was engaged in defending the House privilege. Mr. Dawes, referring to the discussion over the Scott bill of the previous Congress, said: "The same proposition is now before the Senate in a little different form. The bill which now comes back from the Senate * * * is a bill embracing a general revision not only of import duties, but of another entire and distinct field of taxation, that of internal revenue. * * * That provision of the constitution which guarantees to the people's representatives the right to originate all bills of this character seems, if the view of the Senate is correct, to be entirely nugatory."† Mr. Cox argued that "the amendment made by the other body, under the provision of the constitution * * * must be pertinent to our bill,"‡ and Mr. Eldridge said, "If their right to amendment is unlimited, then our right amounts to nothing whatever. It is the merest mockery to assert any right. * * * It is clear to my mind that the Senate's power to amend is limited to the subject matter of the bill."§ Mr. Garfield remarked: "If that bill from the Senate, now on your table, Mr. Speaker, be recognized by us we shall have surrendered absolutely not only the letter but the spirit of the rule hitherto adopted, and with it our exclusive privilege under the constitution."‖ Mr. Butler said: "In my judgment that limit (upon amendment) is this: they may perfect a bill sent them by the House; they may amend the body of such bill; they may propose amendments adding to or reducing the amount of revenue upon the subject matter of the bill, and nothing further. They must stop there."** Mr. Hale declared that "this restriction as to the right of originating revenue bills is worth nothing to the House unless it carries with it * * * a limitation of the right of the Senate to amend,"†† and

*Cong. Globe, 1871-72, pt. III. p. 2105.
†Ibid., p. 2105.
‡Ibid., p. 2106.
§Ibid., p. 2107.
‖Ibid., p. 2107.
**Ibid., p. 2108.
††Ibid., p. 2108.

finally the jealousy of the House and its determination to limit the Senate's power, and to secure its own, was shown in a speech by Mr. Hoar,* in which he attacked Senatorial encroachment upon the Presidential right of appointment. The House agreed to the resolution of Mr. Dawes by a vote of 153 ayes to 9 nays, 78 not voting.

The message with the House resolution, received in the Senate April 2, was laid upon the table. April 8, the resolution was referred† to the Finance committee but without debate, Mr. Sherman merely remarking that the right of the Senate to amend in the case in question was undoubted. April 10, the resolution was reported back with a recommendation that it be sent to the committee on Privileges and Elections,‡ on the ground that the Finance committee had already indicated its opinion on the subject. This was done and April 24 a report§ was made upholding the general position taken by the Senate but disapproving the Senate's action in amending the bill in question.

There was never any debate in the Senate on the report, nor did the Senate definitely agree to the report, although leave was given to print extra copies.

This comparatively short report‖ of the committee on Privileges and Elections is for the greater part one of the most logical documents in the long series of debates upon the constitutional provision in question. A synopsis of the main points of the report follows: 1st. The Senate right to amend can only be understood by noting what were the conditions in England between Commons and Lords. There the Commons had exclusive control of money bills and the Lords could in no way amend, but in the United States the House was given the right of origination, and the Senate was given the right to "amend as on other bills." 2nd. This leads to the question what the right to amend implies. Again referring to England, the Lords had power to amend any bill, except a money bill, in any way they saw fit, and hence, since the right to amend revenue bills, "as on other bills" is conferred by the constitution, the Senate has the right to amend revenue bills as it sees fit. 3rd. The Senate acknowledges that to "raise revenue" is not limited to *increase*, but includes decrease also, and also acknowledges that it has no right to so amend a bill which is not a revenue bill, so as to increase or decrease revenue. 4th. And finally the Senate had no right to amend the House bill as it did because that House bill was not a revenue bill, and some of the Senate amendments did provide for raising revenue. The last

* Cong. Globe, 1871-72, pt. III, p. 2109.
† Ibid., p. 2248.
‡ Ibid., p. 2319.
§ Ibid., p. 2716.
‖ Senate Reports, 2 Sess., 42 Cong., No. 6 to 232., Report 146.

argument was the weak point of the report. The committee held that because the House bill totally repealed all duties on tea and coffee, it was not a revenue bill, and hence that while the Senate could add as many amendments as it pleased totally repealing duties on other articles, it had no right to so amend as to reduce and not repeal a duty, for such reduction was in the nature of a revenue measure. The committee therefore concluded "the House bill under consideration was not a bill for raising revenue within the meaning of the constitution; and therefore that while the Senate might have amended it so as to abolish duties altogether upon other articles, the Senate had no right to ingraft upon it, as it did in substance, an amendment providing, that revenue should be collected upon other articles, though at a less rate than previously fixed by law."* This conclusion has the appearance of furnishing a loophole for escape from an uncomfortable position. But by the same reasoning, if bills to totally repeal duties were not to be considered as revenue bills, the Senate could originate such measures, instead of waiting to amend.

X. *Forty-sixth Congress, 1881. Report of House Judiciary committee on right of the Senate to originate a bill authorizing the purchase of grounds adjacent to the building of Printing and Engraving.*

These two debates last noted, together with the contest of 1855, may be said to have settled the question at issue between the two houses. The Senate continued. however, to originate and to amend bills in such a way as virtually to exercise initiative in matters of revenue and appropriation, yet such bills did not, on their face, directly affect revenue or expenditure. Occasionally even such bills were objected to by the House, and in that case the bill invariably failed to pass. A brief account of such a case is given.

In the Senate, January 29, 1880, Mr. Jones of Florida, introduced† a bill to authorize the purchase of grounds adjacent to the building of Printing and Engraving, and this bill was passed‡ March 1. In the House it was referred,§ March 5, to the committee on Public Buildings and Grounds. This was done without any notice of the fact that the bill made necessary the appropriation of money, and March 11, on the committee's report, Mr. Atkins, chairman of the Appropriations committee, called attention to the nature of the bill, declared it to be in violation of the House privilege, and moved its

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*Senate Reports, 2 Sess., 42 Cong., No. 6 to 232, Report 146.
†Cong. Record, 46 Cong., 2 Sess., pt. I, p. 594.
‡Ibid., pt. II, p. 1215.
§Ibid., p. 1342.

reference to the Judiciary committee in order that the constitutional point might be determined.* Without debate this motion was carried. Thus the subject of House privilege arose quite accidentally and attracted little interest.

The Judiciary committee offered majority and minority reports† on February 2, 1881, and was given leave to print extra copies, but this was all that was ever done with the question. Both the majority and minority reports‡ were carefully worked out. Neither report introduces any new evidence, though that of the majority is the stronger document, asserting definitely the right of the Senate to originate general appropriation bills, and making a clear cut distinction between "money bills" and "revenue bills." A decision by Chief Justice Gray of the Massachusetts Supreme Court is given, in a case involving the question of the right of the Senate of that state to originate appropriation bills. It will be remembered that the provision of the Massachusetts constitution is similar to that of the United States constitution. The decision was: "That the power to originate a bill appropriating money from the state treasury is not limited by the constitution to the house of representatives, but resides in both branches of the legislature." (126 Mass. Rep., supplement pp. 557-602.) On the other hand the minority report cited many authorities to show that an appropriation bill was a "revenue bill" within the meaning of the constitution.

XI. Later discussions in Congress up to 1891. No contest between Senate and House, but incidental debates in both bodies.

Since the famous debate of 1872 over the right of the Senate to amend revenue bills, no similar contest has arisen between Senate and House. However, on numerous occasions the right of the Senate to originate appropriation bills has been debated in one house or the other. There are three such instances worthy of note.

The effect of the report of the Judiciary committee just noted was seen in the next session of Congress, for on June 5, 1882, Mr. Beck introduced in the Senate a resolution § calling on the Senate committee on Appropriations to introduce as soon as possible several general appropriation bills. Mr. Beck's main reason was the delay of the House in sending up the appropriation bills, and the danger of hasty consideration in the Senate. He also cited the majority report of the House Judiciary committee as giving the Senate authority to originate. Mr. Allison objected that the House had not adopted the

*Cong. Record, 46 Cong., 2 Sess., pt. II, p. 1485.
†Ibid., 3 Sess., pt. II, p. 1146.
‡House Reports, 3 Sess., 46 Cong., Vol. I, 1880-81, No. 147.
§Cong. Record, 47 Cong., 1 Sess., pt. V, p. 1408.

report of its Judiciary committee, and thought it would be unwise to adopt this resolution because "the House of Representatives have held for many years that the Senate cannot originate the appropriation bills."* Mr. Hale also opposed the resolution because "it would open all of those grave questions that have been up and settled practically for years as to the right of this body to originate appropriation bills. * * * In all these years there is to be found on the records of the House but a single report conceding that right."† Under the rules of the Senate this resolution could have been called up for vote on the following morning, but no more was heard of it. Mr. Allison and Mr. Hale, as members of the House, had already taken ground sustaining the House privilege in general, though neither had before this debated the specific question of the origination of appropriation bills. Their action in the Senate was certainly consistent with that in the House, and if Mr. Hale's statement is to be accepted the control of the House over expenditure had come to be recognized as supreme.

On the other hand the House itself did not seem to be so consistent. A discussion‡ came up April 11, 1882, over a Senate bill to provide for a deficiency in subsistence for the Indians. Objection was made as usual, and Mr. Randall, Mr. Springer, Mr. Sparks and Mr. McMillan all insisted upon a firm adherence to the right of the House to originate appropriation bills. The difficulty was overcome by the introduction of a new bill in the House and by rushing it through under a suspension of the rules. As to whether the question was to be considered as settled or not, Mr. Randall replied in the affirmative, adding "there has never been on the part of the House, so far as I recollect, anything but an affirmation of its own right to originate appropriation bills relating to the support of the government."§ From these two debates it would seem that both Senate and House had at last come to the understanding that practically *revenue* bills meant *money* bills, and that the term *raising* revenue included *reducing* revenue. The latter proposition, indeed, had not been controverted since the debate of 1871, but on the former the House reversed itself, though its decision was rendered in an indirect way. On January 23, 1885, Mr. Hurd offered a resolution || directing the Judiciary committee to take charge of certain bills received from the Senate, in order that the committee might report on the right of the Senate to originate bills which involved appropriations. The bill which was directly

* Cong. Record, 47 Cong., 1 Sess., pt. V, p. 4509.
† Ibid., p. 4509.
‡ Ibid., pt. III, p. 2770.
§ Ibid., pt. III, pp. 2770-71.
|| Ibid., 48 Cong., 2 Sess., pt. II, p. 948.

involved was what is usually called the Blair educational bill. Mr. Hurd, Mr. Hammond and Mr. Reed discussed the resolution. All three of these gentlemen had been upon the House Judiciary committee of 1881, a majority of which had decided the question in favor of the Senate, and now each took the same position as formerly.* The vote came upon a motion to lay Mr. Hurd's resolution on the table, which was carried by 128 yeas to 123 nays. The House itself had thus conceded in a measure the Senate's right. On the other hand it may well be claimed that there were so many selfish interests at stake in case of failure of the Blair bill that the vote could not be regarded as an index of House feeling.

The evidence that the Senate did not regard this vote in the House as decisive is found in the fact that the Senate has never originated the general appropriation bills. Upon one more occasion the upper house incidentally fell into debate over its constitutional right, and the sentiment seemed to prevail that while the Senate's right to originate appropriation bills was undoubted, permission from the House to go so far as to take the initiative in general appropriation bills was most improbable. The debate† arose May 15, 1888, on a proposed amendment to a pension appropriation bill, and indicated that the Senate was still disposed to originate general appropriation bills, yet did not quite dare to do so. Mr. Edmunds‡ again argued the question at length. Mr. Hoar, who had been advanced to the Senate and who, while he was a member of the House, had attacked so vigorously the encroachment of the Senate, now defended the House. His most important remark was "Gentlemen get up once in three or four years and think that the Senate ought to assert its rights; and that it can assert its rights. The Senate cannot assert its rights. As Mr. Webster originally declared it is a question which must be settled by the House of Representatives, and it has been settled and is settled, and will remain settled by the House of Representatives. It is utterly idle to treat it as otherwise."§ This is the view generally taken at present. So long, however, as the Senate has the right to originate bills, not general appropriation bills, but still appropriation bills, debate will from time to time arise in House or in Senate or between House and Senate on the interpretation of the constitutional restriction.

In reviewing this sketch of debates in Congress it is certain that the interpretation of the constitutional restriction was by no means always the same. The interpretation generally regarded as accepted by

* Cong. Record, 48 Cong., 2 Sess., pt. II, pp. 948-961.
† Ibid., 50 Cong., 1 Sess., pt. V, p. 4151 seq.
‡ Ibid., p. 4152.
§ Ibid., p. 4155.

the House today is not at all that of an earlier period, and hardly the correct one in view of the debates of the constitutional convention. While many debates in Congress seem to have arisen upon exactly the same point, yet there is a regular progression in establishing the principle which is in force today. The earlier contest was between the executive authority and the House, beginning with the debate of 1789 and closing with the law of May 10, 1800, and resulted in a victory for the latter. Then followed a growing antagonism between House and Senate, which meant that one party or the other must give way. The debate of 1833 was carried on entirely by the Senate which therein showed its disinclination to originate what it conceived to be a revenue bill, although that bill proposed to reduce duties. In 1837 the House exhibited a determination to defend its privilege, though its action was no more than an announcement of intention. In 1843, the Senate, by its vote on the Evans resolution, directly disavowed any right to originate a bill reducing the revenue. In 1855 the unsuccessful attempt of the Senate to originate general appropriation bills was a definite assurance that the House gave a broader interpretation to the constitution than that of well known commentators. The debate on the postoffice bill of 1859 was another indication of the House's position, though political considerations affected in no small degree the decision reached. The contest of 1871, on the reduction of the income tax, while it resulted in no formal agreement, must be accepted as settling the question of the Senate's right to originate bills to reduce the revenue as distinguished from bills to raise revenue. The contest of 1872, on the Senate's right to amend, showed that the House was determined that amendments must be germane to the subject matter amended. The debates which have arisen since 1872, with one or two exceptions, have indicated that the control of all great financial matters rests with the House whenever the House cares to exercise it.

The constitutional privilege merely provides that all bills for raising revenue shall originate in the House, but that the Senate may amend as on other bills. The House, however, has gradually come to assert that this constitutional provision means: first, that the House and not the Secretary of the Treasury shall plan the expenditures and receipts of the government; second, that the word "raise" in the constitution means either increase or decrease; third, that Senate amendments to House revenue bills cannot be of such a character as to alter completely the intention of the bills, but must be germane to the subject matter; fourth, that the Senate has no constitutional right to originate appropriation bills, or, in other terms, that the words "revenue bills" are equivalent to "money bills." In summarizing,

then, it is fair to say that what the letter of the constitution secures is the right of the House to originate bills which lay a tax on the people or which remove a tax, and the right of the Senate to originate appropriation bills or to amend revenue bills as it sees fit. But considering the spirit of the constitution another conclusion is reached. The privilege of the House was given for the purpose of securing to the people, through their representatives, the control of taxation. The importance of appropriations in determining taxation was not realized as it is today, nor was it expected that amendments on any measure would be made so as to alter completely its intent. The House must control appropriations and must limit Senate amendments if it is to realize fully the intention of the constitutional restriction. There are of course a great many laws enacted in each session of Congress, and originating in the Senate, which render necessary the expenditure of money, but such laws are passed merely on the sufferance of the House. The House originates all the general appropriation bills and has always done so. The purpose of the constitution is fulfilled in part, in that the House does control financial matters. It remains to be seen whether the House further fulfills the purpose of the constitution in being responsible for such control to the people of the country.

XII. Synopsis of contest in England, between Lords and Commons, over control of financial affairs.

The debates in Congress were, in many respects, very similar to financial debates in the English Parliament, and for the purposes of comparison, a brief account of the latter and of the control exercised by the House of Commons, is inserted.

In England the contest between monarch and people over the principle of self-taxation was not ended until, in 1689, the Bill of Rights finally gave control to the people. Chapter II of that document declares "that levying money for or to the use of the Crown, by pretense of prerogative, without grant of Parliament, or for longer time or in other manner than the same is or shall be granted, is illegal." Parliament never again found it necessary to assert by statute the right of self-taxation. The principle upon which rest all the liberties of the England of to-day, that the people have a right to determine through their representatives the amount and purpose of taxation, was firmly established.* But the contest now arose as to the rights of the

*Fellden in his Constitutional History of England, page 195, gives the following statutes as being those most important in limiting arbitrary taxation:
Magna Charta, 1215: *Confirmatio Chartarum*, 1297: Ordinances of 1311; Right of Tallage abolished, 1340 and 1348; King forbidden to tax wool: 1362, 1371: Benevolences declared illegal, 1484: Monopolies surrendered, 1601, 1624; 1639: Petition of Right, 1628; Ship Money and distraint of Knighthood abolished, 1641; Feudal incidents surrendered, 1660; Bill of Rights, 1689.

Commons in Parliament over matters of taxation. The Lords could not claim to represent the nation in Parliament as thoroughly as did the Commons, and it seemed but a new phase of an old principle that the Commons should possess the sole right of initiative in matters of taxation. Under Charles II the Commons made a formal assertion of such a right, although it had undoubtedly been an active principle of government for a long time. A resolution of the House of Commons in 1678 declares that "all aids and supplies to His Majesty in Parliament are the sole gift of the Commons; and all bills for the granting of any such aids and supplies ought to begin with the Commons; and that it is the undoubted and sole right of the Commons to direct, limit and appoint in such bills, the ends, purposes, considerations, conditions, limitations, and qualifications of such grants which ought not to be changed or altered by the House of Lords."*

This resolution was at once a protest against the amendment of money bills by the House of Lords, and an assertion of the principle that aids to the Crown are the sole gift of the Commons. The Lords did not deny the principle, and the right has long been recognized by the speech from the throne at the opening of Parliament. That portion which refers to the general condition of the nation is addressed to "My Lords and Gentlemen," while that referring to supplies is addressed to "Gentlemen of the House of Commons."† But although the Lords readily assented to the principle that aids to the Crown are the sole gift of the Commons, they have never formally renounced their right of the amendment or rejection of money bills. The two houses did not come into serious conflict on this point until 1860, when the Lords rejected a bill sent up by the Commons‡ providing for a repeal of the paper duties and an increase of the property tax. The attitude of the Commons is well summarized by Anson:§ "The Commons met this action on the part of the Lords by resolutions which set forth the privileges of the House in matters of taxation, and which while they did not deny that the Lords might have the power to reject money bills, intimated that the Commons had it always in their power so to frame money bills as to make the right of rejection nugatory. The resolutions were three in number. The first recites that the right of granting aids and supplies to the Crown is in the Commons alone. The second, that although the Lords have exercised the power of rejecting bills of several descriptions relative to taxation, by negativing the whole, yet the exercise of

*Anson, Law and Custom of the Constitution, Vol. I, p. 231.
†Chicago Tribune, Feb. 12, 1890, p. 5.
‡May, Parliamentary Practice, p. 649.
§Anson, Law and Custom of the Constitution. Vol. I, p. 233.

that power by them has not been frequent and is justly regarded by this House with peculiar jealousy, as affecting the right of the Commons to grant supplies, and to provide the ways and means for the service of the year. The third, that to guard in the future against an undue exercise of that power by the Lords, and to secure to the Commons their rightful control over taxation and supplies, this House has in its own hands the power to impose and remit taxes and to frame bills of supply, that the right of the Commons as to the matter, measure, or time may be maintained inviolate."

The Commons did not at once reintroduce the bill but in the following year the measure was again presented to the Lords, this time forming a part of the general appropriation bill, and the Lords did not dare to tamper with it.* This explains what was meant by the Commons in the resolution in saying that it is "always in the power of the Commons so to frame money bills as to make the right of rejection nugatory." It is simply the custom, familiar enough today, of tacking riders to important bills. Such a proceeding was objected to as early as 1702, when the Lords resolved "that the annexing any clause or clauses to a bill of aid or supply, the matter of which is foreign to and different from the matter of the said bill of aid or supply, is unparliamentary and tends to the destruction of the constitution of this government."† Despite such protests, the Commons have placed riders upon important bills whenever they have feared that such bills would be objectionable to the Lords, and would be rejected if presented alone. The Commons dislike to have the Lords take any active hand in the grant of supplies, yet under certain circumstances they are permitted to amend money bills. In cases where clauses which have no direct bearing on the matter of taxation, are objectionable to the Lords, amendments are sometimes permitted, but so careful are the Commons of their privilege that in agreeing to such amendments, a special entry‡ is made in the journal to the effect that the amendments were "for the purpose of rectifying clerical errors," or "were merely verbal," or were "in furtherance of the intention of the House of Commons."

Sometimes also it is expedient to allow the House of Lords, from its greater knowledge of the subject under consideration, to originate bills which contain clauses relative to taxation. On the third reading of such a bill these clauses are struck out and the bill is sent to the Commons without them. The Commons then take the clauses omitted and print them in their proper place in red ink, with a note

*Hansard's Debates, 3rd Ser., Vol. 163. p. 69.
†May, Parliamentary Practice. p. 648.
‡Ibid., p. 643, ff.

stating that "they are proposed to be inserted by committee" and they are supposed to be in blank until inserted by a formal motion. The House of Commons is, however, extremely jealous of its privileges, and a bill coming from the Lords which contains anything bearing on taxation is likely to be objected to at any time.* In fact the power of the Commons over the grant of supply is absolute whenever the Commons see fit to exercise it. The Commons make the grant, the Lords merely assent to it. The relation between Crown, Lords and Commons in the matter of supply is clearly set forth by May. He says, "The Crown demands money, the Commons grant it, and the Lords assent to the grant, but the Commons do not vote money unless it be required by the Crown, nor impose or augment taxes unless they be necessary for meeting the supplies which they have voted or are about to vote, and for supplying general deficiencies in the revenue. The Crown has no concern in the nature or distribution of the taxes, but the foundation of all parliamentary taxation is its necessity for the public service as declared by the Crown through its constitutional advisers."† The general principle that the Commons will not grant supplies unless they are proposed by the Crown was emphasised by a standing order of March 20, 1866:‡ "This House will receive no petition for any sum relating to the public service, or proceed upon any motion for a grant or charge upon the public revenue, whether payable out of the consolidated fund, or yet of moneys to be provided by Parliament, but what is recommended from the Crown."§ Such a principle is not only a great safeguard against hasty and unwise appropriations, but it ensures a careful balancing of income and expenditure.||

The importance of the control of taxation is nowhere more evident than in England, where the Commons possessing this power, have practically become the sole governing body. In the end, the control of the purse brings with it the control of all matters of legislation.

*For example, June 15, 1860, a bill introduced by the Lords came up for its second reading in the Commons. It provided that persons selling and hawking goods on Sunday should be fined and the fine paid over to the Receiver of the Metropolitan Police district and applied in aid of the expenses of the police. But an objection was made that a good share of the expenses of the Metropolitan and City Police was provided for out of the consolidated fund and hence the bill was one which would lessen the taxation of Her Majesty's subjects, and so was an invasion of the rights of the Commons. Hansard's Debates, 3rd Ser., Vol. 159, p. 539.

† May, Parliamentary Practice, p. 651.

‡ Hansard's Debates, 3rd Ser., Vol. 223, p. 879.

§ Formerly the military estimates were not submitted by the Crown but by a committee of the House of Commons, the reason probably being the fear of the influence of the Crown over the army. But in 1863 this custom was abolished and all estimates are now proposed by the Crown ministers.

|| Yet by means of what are called "abstract resolutions," a member of the House can cause the introduction of a bill relating to taxation. A resolution is presented declaring that such a bill ought to be introduced, and if the resolution passes the ministry will hardly refuse to introduce the bill thus brought to their notice. Such resolutions are certainly contrary to the spirit of the constitution and the standing order of March 20, 1866.

The form of government in England, which permits the plans for legislation to be made by a responsible ministry, gives to the people an effective influence upon financial questions, and as a consequence, upon all questions of public interest. The control of the budget by the people, through their representatives, more than any other thing secures the maintenance of constitutional liberty in England, and its history is really identical with the history of constitutional liberty. The conditions in the United States differ widely from those existing in England, yet a comparison of the position taken by the House of Representatives, in the control of money affairs, with that of the House of Commons is of the greatest interest in an historical point of view, and as indicating the trend of our own governmental development.

C.—Development of Financial Committees in the House of Representatives.

As the House claims the supreme control in financial matters, it also makes itself responsible for their correct management. In this connection it is necessary to outline briefly the history of the method by which the House conducts its business and particularly its financial affairs. Such an outline must necessarily treat of the growth of the system of financial committees now used by the House, for it is by means of committees that business of every sort has been conducted and controlled. The development in the committee of Ways and Means and of others will therefore be traced.

The method of appointment of committees in the House is first noticed in a resolution of April 7, 1789: "The Speaker shall appoint committees, unless it be determined by the House that the committee shall consist of more than three members, in which case the appointment shall be by ballot in the House."* This resolution formed a part of the standing rules and orders of the House. It was soon found that the balloting for members of committees was an intricate and tiresome proceeding, so that January 13, 1790 it was ordered "that hereafter it be a standing rule of the House that all committees shall be appointed by the Speaker unless otherwise specially directed by the House in which case they shall be appointed by ballot."† However, these committees were only special committees, whose existence was dependent in every case upon a formal motion passed by the House. The first committee of Ways and Means‡ was appointed on motion of Mr. Gerry, who found some difficulty in convincing the House that there was any necessity for

*House Journal, 1789-92, p. 9.
†Ibid., p. 140.
‡Ibid., July 24, 1789, p. 65.

even a special committee to consider financial measures.* The appointment of a committee of Ways and Means as a special committee was continued until 1795, when it was made a standing committee to hold during the session, and its duty was defined to be "to take into consideration all such reports of the Treasury department, and all such propositions relative to the revenue as may be referred to them by the House, * * * to inquire into the state of the public debt; of the revenue; and of the expenditures; and to report from time to time their opinion thereon."† But it was not until 1802 that an amendment to the rules of order was adopted that "five standing committees shall be appointed at the commencement of each session."‡ Among these was a committee of Ways and Means, with increased duties and enlarged powers. The rule accepted the exact wording of the resolution of 1795, but specified in addition "it shall be the duty of this committee * * * to examine into the state of the several public departments, and particularly into the laws making appropriations of money, and to report whether the moneys have been disbursed conformably to such laws, and also to report from time to time such provisions and arrangements as may be necessary to add to the economy of the departments and accountability of their officers." This extension of the duties of the committee of Ways and Means, was a part of the plan of attack upon the independent position assumed by Hamilton, and other Secretaries.§

The press of business in Congress soon made it necessary to extend the committee system, and other committees, having a share in the control of the budget, were appointed. In 1814 it was resolved "that an additional standing committee be appointed to be called a committee for public expenditures,"|| whose duty it should be "to examine into the state of the several public departments, and particularly into the laws making appropriations of money, and to report whether the moneys have been distributed conformably with such laws; and also to report from time to time such provisions and arrangements as may be necessary to add to the economy of the departments and the accountability of their officers." However, the committee of Ways and Means remained the most important and most influential of the House, and it was not until 1865 that its duties and powers were lessened in any way. In that year Mr. Cox of Ohio proposed an amendment** to the House rules for thecreation of a new committee on

*Annals of Congress, Vol. I, p. 670.
†House Journal, 1793-97, p. 385.
‡Ibid., 1801-04, p. 40.
§See ante pp. 185-87.
||House Journal, Vol. IX, 1813-15, pp. 311. 314.
**Cong. Globe, Vol. LX, pt. I, p. 666; and Vol. LXI. pt. II. p. 1312.

Appropriations. In support of this amendment he said: "It not proposed to strike out the committee of Ways and Means. This committee is still to be preserved and their future duty is to raise revenue for carrying on the government. This includes of course the tariff, internal revenue, loan bills, legal tender notes and all other matters connected with supporting the credit and raising money. * * * The proposed committee on Appropriations have, under this amendment, the examination of the estimates of the departments, and exclusively the consideration of all appropriations."* The two main reasons given by Mr. Cox for this change were the actual pressure of business on the committee of Ways and Means; and the hope of a more economical management of the finances, since the new committee could make a more careful investigation of bills. In answering the objection that such an arrangement would result in a lack of harmony between the two sides of the budget, Mr. Garfield† said that it would be an easy matter for the committees to furnish each other estimates and confer with each other. The amendment encountered little opposition and was passed March 2, 1865. By it the duties of the commitee of Ways and Means are declared to be "to take into consideration all reports of the Treasury department and such other propositions relative to raising the revenue and providing ways and means for the support of the government as shall be presented or shall come in question and be referred to them by the House, and to report their opinions thereon by bill or otherwise as to them shall seem expedient."‡ That portion of its duties which was now transferred to the committee on Appropriations, was determined by Rules 76 and 77,§ as follows:" Rule 76, "It shall be the duty of the committee on Appropriations, to take into consideration all executive communications and such other propositions in regard to carrying on the several departments of government as may be presented and referred to them by the House:" Rule 77, "It shall also be the duty of the committee on Appropriations, within thirty days after their appointment at every session of Congress, commencing on the first Monday of December, to report the general appropriation bills, for legislative, executive and judicial expenses; for sundry civil expenses; for consular and diplomatic expenses; for the army; for the navy; for the expenses of the Indian department; for the payment of invalid and other pensions; for the support of the Military Academy; for fortifications; for the service of the Post Office department and for mail transportation by ocean steamers; and in failure thereof the

*Cong. Globe, Vol. LXI. pt. II. p. 1312.

†Ibid., p. 1316.

‡See Rules of Order of 37 Cong., House Journal. 1862-63. 3 Sess., Appendix, p. 632.

§Ibid.

reasons for such failure. And said committee shall have leave to report such bills at any time."* Thus the appointment of a committee on Appropriations made it necessary to consider separately the income and expenditure sides of the budget. More than this, in 1883, a subdivision of the question of expenditure was effected, by the appointment of a committee on Rivers and Harbors;† which has the same privileges in reporting bills making appropriations for the improvement of rivers and harbors as is accorded to the committee on Appropriations in reporting general appropriation bills.

Besides these three great committees there are eight others which deal with questions of the budget inasmuch as it is their duty to see that the money given by the general appropriation bills to the various departments is properly expended. But these eight committees have little or nothing to do with outlining the policy of the government in budgetary legislation.

In the Senate the main budgetary committees are those on Finance, on Appropriations and on Public Expenditures. The small size and compact organization of the Senate made it possible for that body to do without the committee system much longer than the House. The first committee on Finance ‡ was appointed in 1815, and this was merely a special committee demanded by an unusual amount of business about to be transacted; but this special committee was of so much value that in the following year a resolution was passed providing for the appointment of eleven standing committees§ on various topics, among them a committee on Finance. The resolution provided "that so much of the message of the President of the United States as relates to the finance and a national currency, be referred to the committee on Finance with leave to report by bill or otherwise." || In 1867 the Senate, following the example of the House, lightened the duties of the Finance committee by the appointment of an Appropriations committee. The resolution authorizing this new committee was agreed to by unanimous consent, all that it was necessary to say being that its purpose was to lighten the onerous labors of the Finance committee.**

The committee system of the Senate need not be considered at length, for it is that of the House and its effect upon the control of money matters which is of particular interest. It is evident that the

*The time limit on the report of the general appropriation bill was first placed in the rules September 14, 1837, and the special privileges given to reports of committees of Ways and Means and on Appropriations were placed in the rules March 19, 1860.

†Cong. Record, Vol. XIV, pt. I, p. 702, and Vol. XV, pt. I, pp. 214-216, 223.

‡ Annals of Cong., 1815-16, I Sess., p. 20

§ Ibid., 1816-17, 1 Sess., p. 30.

|| Ibid., p. 32.

** The committee on Finance now consists of eleven, and the committee on Appropriations of ten, Senators.

committee system is the essential part of the machinery by which the House carries on its business. An argument may be directed, however, against the effect of that system upon the constitutional provision so often referred to and upon the great principle underlying it, that the people, through their representatives, should have direct control of all financial legislation.

D.—The Effect of Business Methods in Congress upon Responsibility for Financial Action.

In the foregoing sketch three points of particular interest are brought out. First: that the struggle for popular control of the purse had been fought out in England before the formation of the United States government, except in so far as the American Revolution was a struggle for this principle, and that the people of the United States inherited the right of control over taxation and expenditure. This is shown by sections in colonial charters, by debates of the constitutional convention, and by state constitutions. Second: events in Congressional history indicate that the House of Representatives regards itself as having by constitutional right supreme power over money bills, in order that control may be guaranteed to the people. Third: the press of business in Congress early led to the assignment to committees of affairs of every sort, thus giving to a selected body of members general direction of monetary questions, excluding, in a measure, other members from an equal power of direction.

Conceding then that the principle of self-taxation, as developed in the English constitution, has been incorporated in the constitution of the United States, and that Congress is today trying to secure to the people the realization of that principle, it is the purpose of the remainder of this paper: first, to indicate wherein the people have failed to secure their constitutional right to the control of taxation; and, second, to consider the various suggestions made for remedying this evil, and to note in what respect they are available or otherwise.

There are now in the House of Representatives forty-seven standing committees, eleven of which have, either directly or indirectly, to deal with questions of the budget. In order to appreciate fully the influence of these committees it is necessary to trace the various stages through which a money bill must pass before it becomes a law.* At the beginning of each session the Secretary of the Treasury presents his report of the financial condition of the government, and his estimates of the revenue and expenditure for the coming year.

*The Budget, Cobden Club Series, pp. 105-123.

These estimates are based upon reports made to the Secretary by the heads of the other departments. They are transmitted to Congress in the shape of a letter addressed to the Speaker of the House, and are then referred to the financial committees of the House. The committee of Ways and Means considers that part of the estimates which has reference to the raising of money, and the committee on Appropriations that part which refers to the general expenditure of money. The estimates are often accepted and bills framed in accordance with them, but frequently the bills are entirely at variance with the estimates. The committees are not even under obligation to examine them. The Secretary of the Treasury has not the privilege of appearing before the House, and can only appear before the committees when invited. The preparation of money bills is therefore really in the hands of the financial committees of the House, and their chairmen may exert greater influence upon methods of raising and expending revenue than any other person save the Speaker of the House. Thus the only official whose duty it is to balance income and expenditure has power to do no more than to suggest such a course.

In tracing a money bill through the stages usually essential before it can become a law a measure proposed by any one of the great committees will suffice as an illustration. When the committee on Appropriations has thoroughly digested the estimates or has made out a new scheme of expenditure to suit itself, it begins to bring in bills authorizing specific appropriations for the various departments. If a member disapproves of the bill presented he may of course introduce a bill of his own. But a rule of the House, which provides that each bill must pass through the hands of its appropriate committee before it can come up for discussion, gives to the chairman power to kill a bill by refusing to report it, unless a majority of the House orders a report. Thus though theoretically each member of the House has an active voice in determining taxation, practically his influence is insignificant unless he is a member of an important committee.* The committee on Appropriations, then, has practically the control of the appropriation of money for the expenses of government. The same thing is true, in their fields, of the other committees. Mr. Woodrow Wilson, in his treatise on "Congressional Government," declares our laws are enacted by committees rather than by Congress.

When an appropriation bill has been passed by the House it is sent to the Senate and there referred, without discussion, to the committee

* When the committee on Appropriations presents a bill, the House goes into committee of the whole where each member is supposed to be privileged to discuss or propose amendments to the bill. But in fact, by a custom of the House, a member cannot gain the recognition of the Chair to propose an amendment unless he has previously made some arrangement with the chairman of the committee on Appropriations. The chairman of that committee is absolute master of the debate. See North American Review, Vol. 128, article by Senator Hoar on "The Conduct of Business in Congress."

on Appropriations. When that committee has submitted its report the bill is either accepted or amended. If it is amended it is sent back to the House for reconsideration. In the case of money bills the House almost invariably refuses to accept the amendments, and proposes a conference committee of three members from each house; the Senate accepts the proposition and the committee usually changes the bill so that it becomes a compromise and fails to meet the real purpose of either house. The question arises, is there anything in this system which prevents the realization of the principle that the people should control the purse? How does it influence the budget?

It is found that two evils result from the committee system. The first is that the origination of money bills by a number of committees prevents homogeneity in the financial measures of the year. The committee of Ways and Means need have no communication with that on Appropriations. Each committee may prepare its bills absolutely without reference to the measures proposed by the others. In the appropriations for ordinary and general expenses of the government the income of the year is probably referred to, and in its consideration of measures for raising revenue the Ways and Means committee must provide for the customary expenditures for the year, but there must result either lack of harmony or a lack of appreciation of the exact needs and conditions in revenue and expense. It is an arrangement which would not be tolerated in any private business enterprise. When the budget of the year is drawn up it should be known just what revenue may reasonably be expected and for just what expenses that revenue is to be used. These might be changed, but if alterations were made it should be by way of cutting out one item and inserting another in its place so that the general estimates would be retained. At present there is not that careful balancing of income and expenditure which would probably be secured if the whole budget were in the hands of one committee. In any other country such a system would long ago have resulted in financial disaster, but until recently the United States has been blessed with a surplus that permitted the Appropriations committee to proceed almost without reference to the propositions of the committee empowered to raise money. Such a system has naturally resulted in foolish expenditure, extravagance and looseness in accounts.

This divided committee system of the House is unwise also in that it lessens the responsibility of the committees to the House. When a committee presents a bill it knows that the House has less interest in the bill than could be relied upon if the effect of the passage of one bill upon other financial measures could be appreciated. Because of this lack of interest the committee knows that the

bill is certain to be less carefully criticised than would be the case if the negative as well as the positive effect of the measure were sure to be examined. As bills are now presented, each appears to stand upon its own merits without consideration of its bearing upon any other which may have been passed or has yet to be presented. Under such conditions the responsibility of a committee to the House is limited to the general advisability of the measure in question, and cannot be extended to the question of effect upon other financial measures.

There is another still greater evil connected with the committee system, that, contrary to the spirit of the constitution, the people cannot promptly secure from Congress any desired financial legislation. According to the theory of the constitution a member of the House of Representatives is directly responsible to the voters of his district. He is to be held strictly accountable for his position on every question before Congress. But with our committee system such a strict responsibility is impossible. A member has practically no power to influence legislation unless he is upon some important committee. Fifteen members of the House determine what bills shall be introduced toward meeting the expenses of the government, and all that the other members have to do on these questions is to "vote with the party." In the majority of cases it is the chairman of the fifteen who has the deciding voice in the preparation of bills. One man, who has in his hands almost absolute control of all appropriation bills, or of all revenue bills, is responsible, not to the whole nation every part of which is deeply interested in such legislation, but to a single district of a single state.*

This is an extreme statement, and there are many ways in which, after all, the power of party or the force of public opinion will compel any chairman to bring in such bills as will meet the popular demand. The real power over legislation is exerted by the person appointing committees and chairman, that is, by the Speaker of the House, but neither he nor his appointee can be held personally responsible to the people at large. Neither Speaker nor chairman could compel the House to pass measures utterly distasteful to it, but the power exercised by each in his respective position is so great

*In this connection it is interesting to note that the irresponsibility of a committee chairman has been referred to in Congress itself. In a speech against the Wilson tariff bill, on February 1, 1894, Mr. Reed, of Maine, said: "In this debate, which has extended over many weeks, one remarkable result has already been reached—a result of the deepest importance to the country. That result is that the bill is odious to both sides of the house. It meets with favor nowhere and commands the respect of neither party. On this side we believe that while it pretends to be for protection it does not afford it, and on the other side they believe that while it looks toward free trade it does not accomplish it. * * * Whatever speches have been made in defense of the bill on the other side whether by gentlemen who were responsible only to their own constituencies, or by the gentleman from West Virginia, who ought to have been steadied by his sense of responsibility to the whole country," etc.—Speech reported in Kansas City *Star* Feb. 1, 1894.

that the will of the majority is often defeated. It is the Speaker who in the last analysis controls legislation, and it is against the exercise of such power by him, under the committee system, that this argument is directed rather than against the chairmen of committees.

By selecting chairmen whose views agree with his own the Speaker has a direct influence upon the course of legislation. In addition to this he has power even against the chairman he has himself selected, as in the event of a conference committee when the appointment of the three House members devolves upon him. Yet the Speaker also, all-powerful as he is, is personally responsible, not to the nation, but to the one congressional district from which he is elected. It is true, the force of party or public opinion serves to control the Speaker inasmuch as his political ambition and loyalty to party will prevent him from conducting his office so as to violate party pledges or policy. The importance of these indirect methods of control is not to be underestimated, yet there should be some real check so as to secure effective responsibility.

There are but two officials in the national government in whose election the voter has a direct voice. These are the President of the United States and the representative in Congress. If the voter fails to secure effective control of the purse through the representative, he can turn only to the President; hence arises the importance of Presidential elections in determining popular wishes. The Presidential nominee, in his letter of acceptance, outlines his policy and his propositions for legislation. The voter of the country, certain to have his own ideas upon public questions, accepts these declarations of the nominees as the basis upon which he decides how he will cast his ballot, and believes that in his vote he has given effective force to his legislative wishes. But the President, for whom he has voted, has no more direct influence over legislation than has the voter himself. Occasionally we have a President who, by mere force of character, gains a powerful influence over his party and compels its members in Congress to do his bidding. But as a general rule our Presidents do not exert any real influence on the origination of legislation. Nevertheless voters hold the President responsible for a power which he cannot exercise, and if the legislation, for which the Speaker of the House and his heads of committees are responsible, does not satisfy the people, they refuse to support the President at the next election. Men think that the policy of the government in matters of legislation is decided by the election of a Presidential candidate while the fact is that the voters simply express an opinion which an irresponsible chairman of a committee is in no way compelled to regard. Budgetary legislation is of the utmost importance

to the nation. Free trade, protection, pensions, internal improvements, expenditures in the various departments, are all questions of budgetary legislation, and are all considered by the intelligent voter before he casts his ballot for President. In this way the budget undoubtedly has an influence upon politics, but on the other hand, politics do not have any marked influence upon the budget. Under our form of congressional autocracy, the vote of the people has not the influence which it should have upon bugetary legislation, or in fact upon legislation of any sort.

It is impossible then for the people to fix any effective responsibility for the use of the public money by means either of the district election of representatives, or of the national election of a President. The President has not the power of the purse and ought not to be held responsible. The Speaker of the House and his committeemen do have the power of the purse and cannot be held responsible under the existing forms.* It was the central thought of the framers of the constitution that there should be a division of power and a consequent division of responsibility, thus obviating the dangers of centralization. But the history of ours and other nations proves that such a division of power is practically impossible for any length of time. Sooner or later some branch of government gains a power almost if not quite supreme. In the United States it is Congress which has become the supreme power, and the Speaker of the House who is its exponent. While the constitution intended a division of power and a division of responsibility, the government which has sprung from it is one in which power has been concentrated in the hands of Congress, while the responsibility is still divided.

Under these conditions it is natural that the public mind has come to recognize something alarming in the spectacle of such unlimited power with such limited responsibility, and to call for reform of some sort by which this trend of constitutional development may be arrested. In this case, proposed remedies cannot be limited to the improvement of budgetary conditions merely, but must include the securing of an effective responsibility for all congressional action. Many such reforms have been suggested, some of them aiming only at improved financial methods, and some of a wider significance. The first suggestion is that the various financial committees be united,

*A quotation from Wilson's "Congressional Government," pp. 331-2, emphasizes this statement: "The average citizen may be excused for esteeming government at best but a haphazard affair, upon which his vote and all of his influence can have but little effect. How is his choice of a representative in Congress to affect the policy of the country as regards the questions in which he is most interested, if the man for whom he votes has no chance of getting on the Standing Committee which has virtual charge of those questions? How is it to make any difference who is chosen President? Has the President any very great authority in matters of vital policy? It seems almost a thing of despair to get any assurance that any vote he may cast will even in an infinitesimal degree affect the essential courses of administration."

so that there shall be harmony in budgetary legislation. The revenue and expenditure sides of the budget would be much more likely to be carefully balanced by one committee than by several. This suggestion would probably result in better business methods, but it would not in any way affect the main question of effective responsibility. It would ensure a more careful consideration of the relation between taxation and expenditure, but it could not secure to the people any real control over either the extent or purpose of such taxation and expenditure.

A second suggestion is, that the number of the members of the House of Representatives be diminished and that the committees be chosen entirely from the ranks of the majority. It is urged that by reducing the number of representatives the number of voters necessary to elect a representative is increased so that he is made a national, instead of a sectional, representative, with national rather than sectional responsibility. This is true only to a limited extent. It might be possible to gain an improved responsibility in this way, but not an effective responsibility. The fewer the representatives the greater will be the influence of any one representative's vote in deciding national policy, and moreover he will be inclined to view questions from a national rather than from a sectional standpoint. But this does not alter the measure of his responsibility to his constituents in any degree. The second part of the suggestion is intended to make the party in power responsible for the propositions of its committees, but it does not appear how it will accomplish this result. In Congress today the majority in the House have a majority of their own number on every important committee. The responsibility of the majority is as effective under the present system as it would be if none but the members of the majority formed the committee. Neither of these suggestions touches the real trouble underlying the committee system of government.

A third suggestion, which does recognize this evil, is that to the President shall be given the power of appointing the chairmen and members of the committees of the House. The argument is as follows: This power could be given to the President without any radical change in the seemingly indispensable committee system. It would, it is true, greatly increase the power of the executive over legislation, but it would not be so apparent a change of the forms of government as to rouse the opposition of the people. It would bring to the voter the realization of his idea, at present erroneous, that in his vote for President he has a direct influence upon legislation. The President, by the appointment of members of committees whose ideas upon financial legislation agreed with his own, would become the one

person upon whom the responsibility for such measures would rest. And it is fitting that this should be so, since the President is the only officer of importance for whom all voters have the privilege of casting their ballots. The President is the only person from whom it is possible to obtain an effective responsibility.

The suggestion is interesting as the only one so far which clearly recognizes and attempts to remedy the lack of responsibility in government. But it seems impracticable, failing to consider the possibility of a President whose political views do not coincide with those of a majority in the House. This may easily come about. Under such circumstances committees appointed by him, reflecting his views, could not possibly possess the confidence of the House, and no committee could hope to do efficient work unless supported by a majority. Such a committee would soon realize its dependence upon the majority whose votes are necessaryto carry out its propositions, rather than upon the President whose power is limited to the privilege of suggestion.

On the other hand, if the President, recognizing the impracticability of appointing commitiees not in harmony with the majority, should lay aside his own plans for legislation and appoint the committees from among the members of the opposition, he would thereby make of no effect the result of the presidential election. He would thus cast upon the House a responsibility which, as has been seen, it is impossible to demand from that body. The suggestion would be practicable only when the President and the House were in harmony. At any other time it could only result in continual disputes between the executive and Congress.

A fourth suggestion is that the United States adopt the cabinet system. There are several forms of this system, but the central idea of each is that of a Ministry responsible to an elected House of Representatives, and remaining in power only so long as the Ministry and a majority of that House are in harmony. In case of an adverse vote in the House, upon some important question, the Ministry must either resign office to an opposition party or appeal to the country for vindication. The suggestion usually made is that the United States adopt as far as possible the English system, but whatever form of cabinet government should be selected it would involve a complete change in our institutions. The most important change would be the election of a President for a long term, and placing him so far above ordinary party politics that he could interfere in no way in the conduct of national business. He would merely be the one to whom the Ministry, on loss of power. should surrender office. His position would be similar to that of the President of the French Republic

today. The real head of affairs would be some member of the party in power who so far possessed its confidence as to retain a majority in the House of Representatives. The Speaker of the House would become a presiding officer simply, for no one could at the same time discharge the duties of Speaker and Premier, Elections would not take place at regular intervals but on occasion of an appeal to the country. The Senate could be left as it is now and would in some measure serve as a check upon too hasty legislation, but even then the introduction of the system would necessitate both radical and minute changes in the present government.

This suggestion involves much more than the mere reform of budgetary rules, yet it is of importance for laying stress upon effective responsibility to the voters of the country, and it is difficult to see how the real control of the purse can be secured to the people, without at the same time securing to them control of all questions of legislation. The most effective argument against the cabinet system is the doubt whether it is adapted to conditions in the United States.

Still another suggestion, likewise meant to remedy the lack of responsibility, is that of the Socialists. They demand that the offices of President and Vice-President, and the Senate, be abolished and that the government be carried on by an Executive Board elected by the House of Representatives. They propose also that all laws of importance shall be presented to the people for their direct vote. It is evident that a Board so elected would correspond nearly to a ministry holding office while supported by a majority in the House of Representatives, as under the cabinet system. The Socialist plan preserves elections at regular periods and includes an executive body elected directly by the Representatives, while the cabinet system does away with elections at regular periods and makes the executive body dependent upon a majority in the House though not directly elected by them. The essential idea of the two suggestions is, nevertheless, the same, that this body is made responsible to representatives, and representatives to people. The same objection holds against both, though in a greater degree against the Socialist plan; namely, that they involve a radical change in the present form of government. If there is a way by which the desired results may be obtained without change of institutions, or with less change, that way merits more favorable consideration.

The serious objection to the third plan of reform stated above was the possible conflict between a President and House of different parties. It remains to determine whether there is any method by which the necessary political harmony between President and House may be guaranteed. Stated briefly the changes which would be

necessary in present customs and institutions are as follows: first, the election of President and members of the House of Representatives for the same length of time, second; the choice of Presidential electors by districts within states, instead of by states as units, third; the giving to the President the right of appointment of committees in the House. The first of these changes would render necessary a change in the constitution, the second would require primarily a change in custom and might involve a change in the constitution, while the third would demand a change in custom only.

The first and second of these proposals have been made many times, but their advocates have had other ends in view than that here proposed. The first proposal would necessitate an alteration in the length of term either of the President or of the Representatives, reducing the Presidential term to two years or increasing that of the Representatives to four. One slight constitutional change would be sufficient for this end in either case. The second proposal would involve, primarily, a change in custom, although a constitutional change might be necessary finally. According to the constitution the legislature of each state determines the method of choosing presidential electors, and it has usually been done by general ticket. Some of the states, however provided for elections by districts but the plan was everywhere abandoned by 1832. Recently it has been revived in the State of Michigan. The necessity for a possible constitutional change is explained by the following conditions. According to the constitution the number of electors to which each state is entitled shall be "equal to the whole number of Senators and Representatives to which the state may be entitled in Congress." Each state would have two more Electors than Representatives in Congress and for this reason either the Electoral districts could not be made to correspond exactly to the Representative districts, or two electors must be chosen at large. As the general ticket vote of a state does not always correspond to its majorities by districts, and the two electors at large might not agree with those chosen in the districts, it is conceivable that the electoral college might elect a President not in harmony with a majority in the House although it is not probable. To obviate this difficulty a constitutional change would be necessaay, reducing by two the vote of each state in the electoral college, making in each state the number of Presidential electors equal to that of the Representatives.

The two proposals already considered involving certainly one, and possibly two, alterations in established institutions, apparently insure harmony between the President and the House of Representatives, but they do not alter in any direct way the nation's power of control

over governmental action. In order to provide this direct control, the third plan, that of permitting the President to appoint the standing committees of the House, must be included in the proposed remedy. The points in its favor have been outlined in the preceding pages. There is no constitutional provision involved. It has been the House custom to give the speaker the power of appointment and to confer that right upon the President would require a change in custom.

The combination of these three proposals secures as great a measure of effective responsibility as does either the cabinet system or the proposal of the socialist party, and with much less change in the written law of the land. In each case, however, it is certain that adoption, whether of the cabinet system, the socialist plan, or that of giving to the President power over committees, means in the end the elevation to great authority of one man who is some how really responsible for his actions. Under the cabinet system this man is the Premier, under the Socialist system he is the chairman of the "Executive Board," and under the last form he is the President of the United States. Each of these proposals necessitates the union to a great degree, of executive with legislative functions, or at least with the function of originating legislation, and in this respect the plans are alike in involving a change in the theory of the constitution. It is commonly asserted that the constitution intended a division of the main functions of government into three distinct heads, executive, legislative, and judicial. While it is doubtful whether such a division is practicable, yet if this principle be accepted as constitutional then it must be acknowledged that any one of the proposed changes directly challenges the theory of the constitution.

In this sketch of the history of budgetary principles and rules in the United States it has been noted that the constitutional convention declared for the control of taxation by the people; that the House of Representatives emphatically asserted the same principle in contests with the Secretary of the Treasury and with the Senate, but that the necessary organization of Congress and particularly the committee system of the House have made impossible a perfect realization of this principle, so that some reform is urgently necessary. Next it has been observed that accepting the committee system as a necessary business arrangement any effective reform which gives the people a control of financial legislation, insures the same responsibility for all other legislation. Finally, it is affirmed that there are at least three ways in which effective control may be secured, but that two of these involve a considerable change in established institutions, while a third involves only minor changes and is therefore preferable. In the end, however, it is conceded that any effective reform must mean a change

in governmental theory in that it partially unites executive and legislative functions.

Thus the proposition of reform is no longer confined to a specific point in the constitution but involves a wider conception of the necessities of the times. Control of the budget means today, as it did centuries ago in England, the control of all government functions. Responsibility for financial management means responsibility for all management. Direct responsibility which may be felt at every election is a necessity of present conditions. The demand today is for good government and much of it and not for a lack of government. The demands of a nation for reform must be correctly interpreted and such demands must be realized. An irresponsible government can not and will not, either correctly interpret or attempt to realize national demands, while a responsible government must always interpret honestly and put in force promptly whatever seems to be the nation's clearly expressed will.

The Character and Opinions of William Langland as shown in "The Vision of William Concerning Piers the Plowman."

BY EDWIN M. HOPKINS.

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The special purpose of this investigation is to give an exposition of the character and teaching of him whose work preëminently, as compared with that of other writers of the fourteenth century, reflects the opinions of the common people. Chaucer, Gower, and Wyclif represent each a distinct phase of life as well as of thought; but all are on a plane removed from that of Langland. He too was a scholar, but a humble one, and he remained ever in close sympathy with the humble; his ideas were either the ideas he received from them, or those which they were eager to receive from him, as is attested by the popularity of his work when written. For this reason the results

herein arrived at may be supposed to index in some sort the mental life of English people of the lower ranks.

The references to texts A, B, and C, respectively, are in every case to the parallel edition of the three texts as published by the Clarendon Press, 1886, in the first of the two volumes of that edition. Volume II. of the same edition is referred to as the "Notes." *R* refers to the poem "Richard the Redeless" as included in Volume I. of the same edition. The other references are given in full, or are self explanatory.

The Scene of the Poem.

Relation to the central subject of inquiry.

Before taking up the central subject of investigation, I wish to consider the scene of the poem and its relation to Langland's life; because, in this case, such an investigation promises to throw some light upon the unsettled question as to whether Langland ever received a university training, and thus partly to account for the nature of his thinking and teaching.

So far as the known facts of his life are concerned, they may be summarized in a few words. These facts are that Langland was born of respectable parentage at Cleobury Mortimer in Shropshire at about 1332; that his father, Stacy de Rokayle, afterward removed to the parish of Shipton-under-Wychwood in Oxfordshire; that the child was baptized in infancy, sent early to school, and loved it so that he determined to be a student all his life, and a scholar according to his opportunities. Here rises the question suggested, as to the nature of those opportunities, and whether access to one of the universities was among them. Professor Ten Brink believes it "most probable" that Langland received a university training, perhaps at Oxford.* If this were true, the poem should exhibit, in addition to a technical knowledge of certain subjects, a reflection of university life in allusions and scenes described.

But whatever may be the conclusion, after our investigation is completed, as to the nature and extent of Langland's training, it is certain that he became a student, and eventually a humble member of the secular clergy; that he married, and spent his life in performing the duties of his profession, studying the Vulgate and the world about him, drawing conclusions from the one, and applying them to the other.

This seems a simple enough matter, but Langland's conclusions and his manner of enforcing them were not as those of other men. The

*Ten Brink, Early Eng. Lit., p. 352.

church of the fourteenth century was a huge machine. Not in organization and government only, but in its methods of preaching and interpreting the Scriptures all was formal and mechanical; the preacher spoke according to rule, often anxious only for the completion of his task, and careless whether the seed thus idly sown should spring up or wither away. Careless whether his flock did or did not follow his teaching, the churchman became careless in regard to following it himself. To formalism succeeded hypocrisy, and open neglect even of formal duties; the church preyed upon the people, and became in turn a refuge for those who sought to escape hardship and make a living easily.

Why the poem was written. Langland entered the church because he preferred the contemplative to the active life. His studies revealed to him not so much new teachings as the fact that the old ones had not been properly applied and enforced. He dared to speak, but the number of those whom he might address personally was very small; and had Langland been simply the faithful priest, we should know as little of him as of a thousand others who have kept the church spiritually alive, when it was most corrupt. But his longing to set forth the truth was not to be satisfied by the performance of daily duty alone; in his otherwise unoccupied hours, his recreation was to write what was in his thoughts, at first, doubtless, without thinking that this work of his leisure was to possess value or importance, but afterward in the full realization of all that it might accomplish. Thus we may interpret his statement that the work is the solace of his lighter hours, through which he strengthens himself for his more serious duties, though he would willingly forsake it if he knew how better to employ the time (B, XII., 20 ff.) But we may detect a growing feeling that the work is worthy, that it is in harmony with his own teaching as to the nature of Dobest; and the omission of even an implied excuse from the final revision of the poem may show his conviction that through it he had accomplished his true lifework.

Relation to author's life. The three several versions of the poem belong, it is well established, to the years 1362-63, 1377, and about 1393. It would seem that we should be able to learn the complete story of the author's life from versions so widely separated in time, and so full of detail and incident; but instead, we are scarcely able to tell anything in addition to what has been stated, except that he lived in London for the greater part of the time. Local allusions are remarkably few, considering the length of the poem; a fact due to the allegorical structure of the composition; and of these local allusions, fewer still, except those which pertain to the

city of London, are of such a character as to indicate that the author had personally visited the places mentioned.

Date of coming to London. An interesting question may be asked, the discussion of which must be largely speculative, as to the scene and occupation of Langland's life before he became a resident of London. That he had become somewhat familiar with London before the earliest version of his poem (Text A) was written, is scarcely open to doubt, though were it not for the exceedingly circumstantial and graphic character of a single portion (A, V., 146 ff.), describing a London tavern, it would seem that his familiarity with the city was not so great as to indicate long residence. To me, Text A seems to breathe a spirit of the country; with the exception mentioned, its London allusions are general in character, and might be based upon common report, while many of the characters described were to be met with very often in the country as well as in the city. Perhaps the safest conclusion is that Langland had but recently come to London, and that he was still dominated by the influence of the earlier country life.

In the C-text is found the positive statement, "I haue lyved in London meny longe ȝeres" (C, XVII., 286). It happens that the corresponding passage in the B-text (B, XV., 148), states, "I haue lyved in londe, quod I, my name is Longe Wille;" and while this may be and usually is interpreted as an introduction of the author's own name into the text,—an interpretation justified by precedent, and by other examples in the text itself of playing upon words,—it may also be interpreted as referring to a life in the country, and as meaning that Langland had not yet lived in London so very many years. Still there is no further evidence to show whether he had lived there more or less than fifteen years, (interval from A-text to B-text), and thus to fix the date of his arrival as earlier or later than the A-text, except such evidence as may be gathered from the general atmosphere of the A-text. I conclude that he came to London at about the time that the A-text was written, certainly not much earlier; and that he married at about the same time, as his daughter had arrived at years of understanding when the B-text was written. (B, XVIII., 426).

The standpoint of the A-text is certainly in the country. The author places himself there three times in as many visions, (A, prologue, 10: A, V., 6: A, IX., 58), and the action of the poem is also in the country, with the exception of certain episodes. The "field full of folk," and the marriage of Meed, are in the country; the trial of Meed transports us to Westminster, but we return again to the field of folk, the preaching of Reason, and the appearance of Piers Plowman, who

could not well be other than a countryman. The penitents are from both city and country.

The chief distinction between the A-text and the C-text in respect to scene is, that in the latter London dominates. Further, in the C-text, the author awakes in London after going to sleep on Malvern Hills (C, VI., 1), goes to sleep again in a London church (C, VI., 108), and wakes again in time to see the sun set in the south from Malvern Hills (C, X., 294). This inconsistency, due to the interpolation of new matter, would seem to furnish some evidence touching the place of composition of each version; but the value of the evidence is destroyed by the fact that the B-text, which was evidently written after the London residence had begun, is here in acccord with the A-text, instead of the C-text, as it should be if the change noted were due to a change of residence.

Though the A-text has more to do with the country than with the city, the argument that it might have been written before Langland had become thoroughly familiar with London has to offset it the fact that the allusions to places in London are more specific than those to places in the country, and more numerous as well. Malvern Hills may be definitely located; and the field full of folk may be near them; so too may be the half acre of Piers Plowman; but supposition is not certainty. On the other hand, Westminster is a definite locality, and so are the various places whose representatives meet Glutton at the tavern, though the tavern itself is not named.

Though we may not therefore fix definitely the time when Langland came to London, it seems evident that in 1362 he was acquainted with both city and country; that he loved the country rather than the city, an allegiance still cherished fifteen years after; and that he had not long forsaken the Malvern Hills for the London streets.

Occupation of earlier years. If Langland spent much of the earlier part of his life in the country, as seems reasonable, it becomes of interest to ask how it was spent. He shows entire familiarity with the plowman's life, his duties, and even his food at the several seasons of the year. No others of his descriptive passages are so minute and so evidently accurate as those relating to rustic life and labor. There is, I believe, more than a possibility that the boy Will, before his assumption of clerical dignity, had formed a practical acquaintance with the duties of the farm and the harvest field, and had found them not at all to his taste. The question addressed to him by Reason (C, VI., 12), "'Canstow serven,' he seide, 'or syngen in a churche?'" might indicate that, at the time Langland had in mind, he had not yet become in any sense a priest; though before the end of the passage is reached, he is speaking of his long clothes, and

declares that he lives in London. But he has so often shown a facility in making sudden transitions of thought, that we may still be permitted to think that the reference in the beginning of the passage is to an early time spent in a sort of vagabondage. He also accuses himself elsewhere, and in a very sweeping way, of having devoted altogether too much time to the world, the flesh, and the devil. But on the other hand, the passage quoted may mean only what is distinctly implied in another (C, VI., 91), that Langland was at no time formally attached to priory or minster; and his self-accusation may be a natural expression from one who despises the things of the world. If this be the case, he probably obtained his knowledge of country life upon the farm held by his father, and by later inspection while journeying about in his long robe, as too many clerics were wont to do. The most that can be said is that there is a possibility that some of the days of his youth were wild and idle, and a probability that others of them were spent in acquiring a practical knowledge of seeds and seasons (C, XIII., 177-192), and of farming operations in general (C, XXII).

Inferences from allusions to places.

We may attain to something more of certainty in regard to the scene of Langland's life and labors taken as a whole. The total number of allusions to to places in England outside of London, as tabulated in Professor Skeat's index, is but sixteen; a surprisingly small number. These indicate a general acquaintance with the country lying between Shropshire and London, a territory that is very nearly the geographical center of England; and the places mentioned seldom lie far away from a line drawn from Langland's birthplace to London. Extended to the northwest, such a line would pass near Chester, and to the southeast, not far from Canterbury. A few names carry us from London northeastward into Norfolk; but these are of a general or proverbial character, not usually indicating actual acquaintance. It is otherwise with allusions to places between Shropshire and London. There are also some rather specific references to places in Hampshire, southwest of London; while if we take account of the poem of "Richard the Redeless," Langland in 1399 had passed westward as far as Bristol. Apparently the greater part of his life was spent near London; the earlier part of it in a gradual moving down from the Malvern Hills to London; and perhaps its latest years in a journey westward. Without doubt the entire action of the poem we are to study, so far as that action lies in England, lies between and about London and the Malvern Hills; while of other parts of his country, Langland knew little, save by hearsay.

The Content of the Poem.

While materials for the history of Langland's outer life are very scanty, as may appear from the preceding discussion, the mass of those bearing upon his inner or mental life is proportionately great, and to give a complete exposition of them would require a volume. The results which follow have been obtained, after tabulation, by endeavoring to compress into a few words the substance of many citations, and to substantiate each point by a single appropriate reference.

1. SCIENTIFIC INFORMATION.

Langland's attitude toward real and pretended science is less satirical than that of Chaucer, perhaps because Langland had given the subject less attention; still in speaking of the arts which pertain to magic, he does express considerable distrust. To the "seven arts" which comprised the circle of scientific knowledge of his time, he twice refers (C, XII., 98; C, XIII., 93); but the character of his work would not indicate that he had been a very diligent student of any of these arts, except perhaps grammar. The seven arts mentioned are the trivium,—grammar, logic, and rhetoric, and the quadrivium,—music, arithmetic, geometry, and astronomy.

It is evident that this circle of arts does not include all human knowledge, nor is it broad enough to cover all the learned allusions made by Langland himself. To make the classification more complete, it will perhaps be best to refer to the source from which popular knowledge upon matters of science and philosophy was largely derived, the "Secretum Secretorum" (Morley, English Writers, IV., 227); a book which Langland appears not to have known. This work is summarized by Gower in the seventh part of the "Confessio Amantis," and his summary may answer our purpose. Knowledge is arranged in three classes, — Theoretic, Rhetoric, and Practic. Theoretic includes theology, physics, and mathematics; mathematics in its turn comprising arithmetic, music, geometry, and astronomy, or the quadrivium. Rhetoric includes grammar and logic, and Practic includes ethics, economics, and politics.

Gower discusses the constitution of created things as if the subject belonged to mathematics rather than to physics. It is necessary also to find a place for alchemy and medicine in the scheme of knowledge before we can give a logical place to Langland's remarks upon those subjects. Perhaps the shortest road is this, that astronomy includes astrology; from astronomy, astrology, and geometry, comes alchemy; and medicine is the application of astronomy, astrology, geometry,

and alchemy, to unfortunate human beings. Or medicine belongs to the geometrical and astronomical department of mathematics, where Gower discusses it; a conclusion according with that based upon Chaucer's description of the physician (Canterbury Tales, prologue, 411 ff.).*

The Elements. It appears that Langland had no clear idea of any system of knowledge. At least he utterly refused to be bound down by any received system upon any subject, whether because his knowledge of received systems was inexact, or because he cared more for the exactness of his metre and alliteration than for all the systems under the sun. For example, according to Gower and the "Secretum Secretorum," the four elements of things created are earth, air, water, and fire, with a fifth element, *orbis*—the shell which surrounds all the others. Langland in one place gives them as earth, air, wind, and water (C, XI., 129), where he may be using *air* for *ether*, or the heavenly fire (Skeat, Notes, p. 138), and is simply confused by different authorities. In another passage he deliberately drops out *earth*, and for a special purpose substitutes *wit*, making the list wit, water, wind, and fire (C, X., 56).

Alchemy and general sciences. To correspond to Gower's grave discussion of alchemy, and Chaucer's satirical one (Canon's Yeoman's Tale), Langland has a brief and general passage whose subject is the sciences in general, and alchemy among the rest. (B, X., 168 ff.). Dame Study in naming her accomplishments, states that she has taught logic and many other laws, trained Plato and Aristotle, educated children in grammar, and contrived tools for all kinds of crafts. Having thus placed the handicrafts on the roll of sciences, the dame turns her attention to more abstract subjects, and finds of them only Theology really worthy. Yet Theology has puzzled her ten score times; the more she mused thereon, the mistier it seemed, and the deeper she divined, the darker it became. In fact, she concludes, it is no science at all, but a soothfast belief, a matter of faith. Love is its cardinal doctrine, and there is no science under the sun so sovereign for the soul. Then, in comparison with Theology, the other sciences are briefly and finally disposed of as follows:—

> But astronomy is an hard thing, and evil for to know,
> Geometry and geomancy are guileful of speech;
> Whoso thinketh to work with those two thriveth full late,
> For sorcery is the sovereign book that to the science belongeth.
> Yet there are contrivances in caskets of many men's making
> Experiments of alchemy the people to deceive—

*See also Saunders' Chaucer's Cant. Tales, pp. 111-125.

or as text A here reads (A, XI., 157),

> Experiments of alchemy of Albert's making;
> Necromancy and pyromancy the devil to rise maketh.

Text B continues—

> If thou think to Do Well, deal therewith never;
> All these sciences I myself subtled and ordained,
> And founded them first, folk to deceive.

Astronomy and astrology.

This condemnation of astrology and astronomy is not adhered to consistently throughout the poem. Langland makes use himself of a warning from Saturn, though perhaps satirically (C, IX., 349); he expresses belief in the favorable influence of a constellation (C, XV., 30), and says that Grace teaches astronomers and philosophers to see and say what shall befall (C, XXII., 242); and conversely, the failure of predictions is ascribed to the evil deeds of the people, and their lack of faith (C, XVIII., 96 ff.).

The greater number of allusions pertain to popular beliefs with reference to medicine, and to natural history; the latter doubtless derived from the Bestiaries, Latin and English, except some of the most ordinary facts of observation. There is a somewhat extended discussion of the habits of beasts and birds (B, XI., 326; C, XIV., 143 ff.), based partly on observation and partly on Aristotle at second-hand. Langland mentions the growing of precious stones (A, XI., 12), the cricket's living in the fire, and the curlew on air (C, XVI., 243); and in Richard the Redeless (Passus III), he tells how the hart, by swallowing an adder, renews its youth, and how young partridges forsake their foster mother for the true one.

Medicine.

One of the prominent medical allusions is the mention of triacle (treacle) or salve, the remedy for poisons made from the flesh of vipers (Skeat, Notes, 227) suggesting the principle, Like cures like, which is formulated elsewhere (C, XXI., 158). Precious stones cure diseases and poisons (B, II., 14).* Walnuts, if the shell and bitter bark be removed, will increase the strength and benefit the general health of old men (C, XIII., 144). The virtues of plasters were understood (C, XXIII., 314, 359), sleeping draughts were employed (C, XXIII., 379), and many drugs were in use (C, XXIII., 174). A full list of common diseases is given (C. XXIII., 81) comprising fevers and fluxes, coughs and consumptions, heart spasms, cramps and toothaches, colds and catarrhs, running sores, boils and swellings, agues, "frenzies and foul evils." Leprosy was not unknown (C, X., 179). More terrible than

* C, IX., 189, "And lame men he leeched with lungs of beasts," probably means that the lungs were given for food.

all was the plague, against which neither "dias" nor drugs nor physicians might avail.

Hygiene. Hunger is a better doctor than any physician (C, IX., 268 ff.), and often Langland gives evidence of faith in diet and hygiene that is refreshing, and not less so that it is based not upon learned treatises, but upon literal interpretation of the Scriptures, and upon common sense. He believes in labor and temperance for the physical health no less than for the spiritual; and if one labor and be temperate in all things, then, says Langland (C, IX., 293),—

The Physician.

> "—ich dar legge myn eres
> That Fysyk shal hus forrede hodes for hus fode sulle,
> And hus cloke of Calabre for hus communes legge,
> And be fayn, by my faith, his fysyk to lete,
> And lerne to labore with londe leste lyflode hym faile,"

And finally passing from satire to serious earnest,—

> "Ther aren meny luthere leches and leele leches fewe,
> Thei don men deye thorgh here drynkes er destyne hit wolde."

Langland doubts as does Chaucer, the efficiency of even the best of physicians, and regards them always with a lurking smile. There may be no hint of irreverence in the allusion to "Nedde the fisicien" (A, VII., 170), though the designation looks suspiciously like a modern nickname; or in the account of the conflict of age with a physician (C, XXIII., 176)—

> Eld aventured him on Life, and at last he hit
> A physician with a furred hood that he fell in a palsy,
> And there died that doctor ere three days after;—

but the meaning certainly seems to be that the members of the learned fraternity were ornamental rather than useful. Elsewhere (C, XXIII., 171) we learn that the doctors take gold, good won, and give in return the imaginary protection of a glass hood. Langland has expressed himself more briefly than Chaucer upon this subject (C. T., Prol., 411–444), but not less to the point.

Grammar. Langland's familiarity with the subject of grammar is indicated (C, IV., 335 ff.). He compares Bribery and Reward to the direct and indirect relations in grammar. The substance of this distinction is that reward is what one receives after duty done, that is after conformity to rule, divine or human, the former especially; just as an adjective or substantive accords with its antecedent in gender, number, and case. The bribe is what is received through self-interest entirely, and lack of conformity to rule, such as is seen in the indirect grammatical relation, in which there is lack of agreement in number and case. The meaning of the term, "indirect relation" is not clear; nor was it clear to the king, who states that

"Englisch was it neuere," (C, IV., 343). The passage is chiefly of interest as showing that Langland was in his later years paying especial attention to the subject, perhaps in connection with the revision of his poem. The passage ends with a comparison of mankind to a substantive, and of Deity to an adjective of "three true terminations."

Langland's interest in grammar is also shown in the B-text (B, XV., 365); he there terms it the "ground of all" and complains that it no longer receives proper attention, unless from children:—no new clerks can versify fair, or formally endite, and not one among a hundred can construe an author in any language but Latin or English. In the corresponding passage in the C-text he omits the implied praise of French, and states only that none can now construe naturally what poets made. In both passages one detects that Langland was very proud of his own knowledge of the theory and practice of this science.

2. POLITICAL AND SOCIAL THEORIES.

As Langland's whole structure rests upon a moral basis, a difficulty arises in making a clear distinction between what is ethical and what is economic. The expressions of his political opinion have reference chiefly to the duties which the several classes of society owe each other in accordance with Scriptural law.*

Classes of Society. Langland's classification of society is fivefold, comprising king, knights, clergy, commons, and plowmen (B. Prol. 112–120). Their general relation to each other is specified as follows (Ibid):—

> Then came there a king, knighthood him led,
> Might of the commons made him to reign;
> And then came kind wit, and clerks he made
> For to counsel the king, and the commons save.

The king, and knighthood, and clergy as well, determined that the commons should provide for themselves, and presumably for the rest; and the commons therefore contrived crafts, and for profit of all ordained plowmen to till and labor. The king and the commons and kind wit the third shaped law and lóyalty, that each might know his own.

Text C (I, 139) varies this passage in a manner that is very suggestive. The king reigns not specifically by might of the commons, but "by much might of the men," which may be interpreted to mean knights instead of commons. Instead of the king, it is conscience and kind wit that with knighthood decide as to the first duty of the commons. Lastly, instead of establishing a separate class of plowmen, the commons simply make a plow, which presumably any of

*Compare with the discussion of moral duties.

them might use. I interpret this to mean that in consequence of the jealousy existing between the king, Richard II., and the commons, and of the uprising of the lower classes under Wat Tyler, Langland, without changing his opinions, so modified this expression of them as to remove any cause of friction there may have been in his original blunt statement.

The sub-classification of the clergy and commons in respect to rank, profession, or trade, is reasonably complete and minute. The most considerable list is given in the description of the field full of folk, (A, Prol.). A general resume is as follows. The religious occupations, professions, or orders, comprise anchorites and hermits, pilgrims and palmers, the four orders of mendicant friars, pardoners, parish-priests, bachelors, bishops, cardinals, and the pope. The commons is resolved into the legal profession with its various grades and officers,—magistrates, sergeants, "sysours and somners, shereyves and here clerks," beadles, bailiffs, advocates (cf. C, III., 59); merchants, petty tradesmen of all sorts, and handicraftsmen, as bakers, butchers, and brewsters many, woollen websters and weavers of linen, tailors, tanners, and tuckers also, masons, miners and delvers, cooks and taverners (A, Prol., 98–109). Then may be added those who live upon others; minstrels, beggars, jesters (A, Prol., 32–40; cf. corresponding passages in B and C).

King. The passage quoted (page 243) names as the fundamental divisions of society, or the three estates, the nobility, the clergy, and the commons. The source of the royal power is laid down in language unmistakable. Then follow specific maxims for kingly guidance, besides the general teaching that may be gathered from the fable of the cat and the rats (B, Prol., 145), and from the poem of Richard the Redeless.

Deriving his power from the commons, he owes to them, in return for service and obedience, "law, love, and lealty," absolute impartiality (C, IV., 381), faithful observance of law (B, Prol., 140), and protection from all enemies. That is, he is recognized as a judge who must be both just and merciful (C, I., 152), an executive, a commander, and in some sense a lawmaker; though as to the latter point, it would appear that he may legislate for the commons by their courtesy rather than by right (B, Prol., 143). As executive, he may claim the help of the commons in enforcing the law, and may not easily succeed without it (C, V., 176). He may also claim of the commons financial support, but should rather ask than demand (C, XXII., 467 ff.). He is subject to the laws as well as charged with their execution, is responsible to the power that created him (the commons) in that he may forfeit their love and respect, though Langland hesi-

tates to include the right to rule under things forfeitable; and finally he must be guided in all things by the law of God.

Langland's disinclination to advance revolutionary teaching is clearly shown in the fable of the cat and the rats. The rats (burgesses or upper classes) and the mice (lesser commons) have suffered most seriously from the interference of the cat (the king) with their rights of property and personal liberty. But the redress proposed is simply to secure a means of knowing in advance what the movements of the cat will be, ignoring the fact that it would be quite as easy to imprison the cat, or destroy him utterly, as to hang a bell on his neck. Finally a mouse reasons philosophically, in view of the difficulty of carrying out the proposed plan, that submission is best. A king may be bad, is the teaching, but if there were no king, or if his power were more restrained, his subjects might prey upon each other. Even a bad king will maintain peace at home, and will sometimes cease his domestic depredations to prey upon foreigners.

While there is here implied a remonstrance against the impositions of the king (Richard II), Langland's complaint is probably not so much against the enactments themselves as against those who carry them into effect. This is directly stated in Richard the Redeless. Courtiers, retainers, purveyors are all robbers, and the king's chief fault is failure to protect his people against his own creatures.

Knights. Langland pays the order of knighthood the high compliment of making Christ a member of it, who jousted at Jerusalem in defense of humanity. It shares with royalty the duty of defending and protecting the commons against foes, trespassers, and even animals and birds of prey (C, IX., 19-34). Courtesy and physical prowess characterize the knights, rather than intellectual ability; and their first duty is to maintain truth. "Truly to take and truly to fight is the profession and the pure order that appendeth to knights, and whoso passeth that point is apostate of knighthood" (C, II., 96 ff.). Knighthood was established in heaven, and the punishment of Lucifer may serve as a warning to the knight who forsakes his high trust. Only those may receive it rightly who have land and lineage, and are otherwise worthy (C, XIV., 111). Langland is at one with Chaucer in the respect accorded to the order; but this respect does not prevent him from revealing the fact that there are knights base and unworthy, who have purchased their spurs by means of money or influence, and not through any knightly merit (C, VI., 72-79).

Commons. The general status of of the commons has already been defined, in discussing that of the king. Between commons and king stand the magistrates, ministers of the king to interpret the law and enforce its penalty, yet chosen from the commons (A, III.,

67). To their position they should rise through an educational qualification, we may infer; since Langland apparently believes that this is precedent to any exercise of power, even rightful power. It is the duty of the uneducated rank and file, those who do not understand Latin, to serve and suffer, to accept the words of the king as their law, and to put all their trust in him. Through Latin lies the road of aspirants to participation in government, first in an advisory capacity, and then perhaps in a judicial one; though a judicial position is secured through the will of others rather than one's own inclination. Those who are, through education, competent to act, will see the folly of hasty and inconsiderate action.

The chief good of the commons is, then, to be secured by their resigning the governing power into the hands of natural or chosen rulers, and by fulfilling the precepts of the moral law. The seat of the advisory and judicial power is indicated with reasonable clearness, but it is not so clearly indicated what Langland believes to be the seat of legislative power. He does not say outright that it belongs either to king or commons, but he seems to imply that the power resides in the First Estate (king and nobles) by sufferance of the commons; and this accords with the statement made by Freeman (art. England, Enc. Brit., VIII.), that at this time the form of legislative procedure was for the commons to petition, and the king and lords to enact at their request. Another reason for Langland's silence upon this point is doubtless that in his opinion the law of Holy Writ is sufficient. We detect the spirit of Magna Charta in his work, but we are unmistakably shown that to him the Great Charter is the law of God.

Plowmen. The precise meaning of the term *plowman* in the poem is open to discussion. Is Piers Plowman himself a free tenant, or a villein, the legal restrictions upon whom are thus stated (C. XIII., 61): No churl may make a charter or sell his cattle without the consent of his lord; if he run in debt, or leave his place of abode, he is liable to imprisonment. Langland says that no clerk should be tonsured unless he were come of franklins and free men, and wedded folk (C, VI., 63); but he nowhere makes Piers Plowman a tonsured clerk. Piers proposes, as a free man might, to leave his half acre, and guide the pilgrims to Truth (C, IX); but his absence is apparently not to be permanent. Freeman defines a churl (see reference above) as a member of the lowest class of freemen. This class after the Conquest became fused with that of the slaves into the intermediate class of villeins, who were not slaves in person, but not wholly free in law. It may be that with Langland, the plowman and the churl are the same, but that in describing the one, he is thinking of his

constantly increasing privileges, and in defining the other, of his exact legal status. Or he may have in mind the distinction pointed out by Skeat (Notes, 169) between the two principal classes of villeins, the first of whom "were allowed many indulgences, and even in some cases, a limited kind of property;" and all of whom, Freeman states, became entirely free by the end of the fifteenth century.

It is evident that by plowmen Langland means laborers attached to the land, because (C, IX., 331) after having described the food and implements of the plowman, he makes a comparison, in the main unfavorable, between him and the "laboreres that han no londe to lyuen on bote here handes;" and it was probably this movable contingent that was in such demand after the pestilence, and concerning whom a law was passed limiting wages, and prohibiting traveling from one parish to another. That Piers has some property rights is shown by his making his will, and in its specifications (C, IX., 95); but still he owes allegiance to his lord Truth, holds under him, and receives from him instructions as well as deputed power.

My conclusion then is that Piers Plowman, as he at first appears, is a villein of the highest class. So far as he has a political significance, it is as a member of the commons; but in the nature of things he can have little until his emancipation is complete.*

Clergy. The office of the clergy is purely spiritual, and though they, especially the higher prelates, do meddle with political matters, they have no business to do so, except in an advisory capacity. Even in the matter of collecting tithes, their authority is non-political. They possess however certain rights of protection over members of their own body and others, illustrated by the right of sanctuary, benefit of clergy, and even the neckverse (C, XV., 129) that may deliver a thief from the gallows.

Economic theories. Economic theories, properly so called, are hardly to be found in the poem; but rather economic facts; though occasionally Langland gives expression to an isolated opinion that has an economic bearing, as for instance the following:

"In marchaundise ys no mede, ich may it wel avowe.
Hit is a permutacion a-pertelich o pene-worth for another."

(C, IV., 315). That is, in trade is no reward or bribe, but simply fair and open exchange, presumably taking account of labor involved as well as of the value of the commodities.

The "interesting allegory concerning questions of natural economy" mentioned by Ten Brink (Early Eng. Lit., p. 360) is an allegory concerning the want that preceded the pestilence, and the demand for

*For discussion of the religious significance of the character see topic *Christ as Piers Plowman*.

labor and the consequent plenty that followed it. Hunger proves himself as good a political economist as he is a physician, in compelling the idle to labor, and in providing food for them and the helpless (C, IX., 171 ff.). After the pestilence, when Hunger slept, laborers refused all but the best of fare and the highest of wages (C, IX., 331). Besides the general recklessness that accompanied and followed the plague (C, XXIII., 150), marriages became frequent and reckless (C. XI., 272), with the most unhappy results. The political conclusions are not far to seek, though Langland does not draw them, contenting himself with the moral ones.

"Seldom mosseth the marble-stone that men oft tread." One should not change craft or religion without good reason, and whether married or single, should not become a "runner about" from one place to another (A, X., 87 ff.).

God provided for man the three necessaries of life,—food, drink, and clothing. These are for all, and should be partaken of, in measure, by all (C, II., 20). He gave the elements to serve man, and hence these, that is wit, water, wind, and fire, should be free to all (C, II., 17; C, X., 55).

Though Langland teaches that Christian men should be in common rich (C, XVII., 43), his indignant renunciation elsewhere of the communistic principle (C, XXIII., 277) must mean that he believes not in actual community of ownership, but rather in reasonable equality; those who have more, caring from their abundance for those who have less.

Langand is also alive to some of the evils and dangers of municipal life (C, IV., 90 ff.). Where the good and evil are so closely associated together, it must often happen that the good suffer with the evil, as well as because of them.*

3. THEOLOGICAL AND RELIGIOUS TEACHING.

On other subjects Langland may have held reflected opinions; here if anywhere they should be his own. Yet we find little of novelty. His teaching is simply the teaching of the church, but he shows how far from this teaching has diverged the practice of men. This was apparent to many others. Gower too spoke in the "Vox Clamantis" (1381), but not until after the voice of Langland had been heard, and had produced marked results.

Here as elsewhere Langland states his doctrines, whether of theology, religion, or ethics, not systematically, but as they are needed to enforce some practical truth; and it is doubtful whether he had

*The description of the life. of various classes ofsociety, especially the very poor, is of economic importance, but has been fully discussed by Geunther. See "Englisches Leben."

ever given any attention to the attempt of the scholastics to systematize and explain, though he necessarily made use of their conclusions, as far as they had become a part of the doctrines of the church. In proceeding with the treatment of this topic, I shall aim to separate the formal and doctrinal from the practical.

a. THE SUPERNAL AND THE INFERNAL.

The Trinity. The doctrine of the Trinity is repeatedly enunciated, with profuse illustration. God is Truth, or His throne is Truth, "the trone that trinity ynne sitteth" (C, II., 134). Belief in the Trinity is the most fundamental of the articles of faith (B, X., 230-238). There are three Persons, but each is God himself, and all are God, and are "nouȝht in plurel noumbre;" yet in the act of creation, God though "synguler hym-self" used the plural verb *faciamus*, thus implying, Langland says, that a greater agency was at work than His word alone (B, IX., 35). God is without beginning; the Son is the savior from death and the devil; the Holy Ghost is of both; and the Trinity is the Creator of man and beast. This is the summary of the "artikle of the feithe;" but this is hard to understand, hence the illustrations elsewhere given.

God in the act of creation, but without the Son and Spirit, would be as a lord who would write letters but lacked a pen and parchment (Ibid.). The three Persons of the Trinity are the three props of the tree of Charity (C, XIX., 1-52). Against the world stands *Potencia-Dei-Patris;* against the wind of the flesh resists *Sapiencia-Dei-Patris,* which is Christ; and *Spiritus-Sanctus* is used to support the tree when shaken by the devil, and also as a weapon to strike him down.

Christ's coat of arms, when he jousts in the armor of Piers Plowman (C, XIX., 188, and parallel passages in B), is three Persons in one banner, each separate from the other, yet one speech and one spirit springeth out of all; there is but one wit and one will, and though "sondry to seo upon, *solus deus* he hoteth." The Trinity is like Christ, Christendom, and the Church, or like Adam, Eve, and Abel, that is husband, wife, and child. Eve proceeded from Adam, and Abel was of them both, yet these three are but one in manhood. So is the Son of the Father, and the Holy Spirit of them both (C, XIX., 210-240). Abraham states that God appeared to him as three Persons "goyinge a-thre right by my gate," and in what follows is a curious adaptation of the grammar to the circumstances. Abraham rose up and reverenced God, and right fair greeted *Him*, and washed *their* feet and wiped them. After *they* had eaten, *He* told Abraham and his wife their inmost thoughts (C, XIX., 245).

The Trinity is like a hand (C, XX., 111-167). The Father is the fist, including the Son and Spirit; the Son is the fingers, and the Holy Spirit the palm. The Trinity is like a candle (C, XX., 168-228) of wax, wick, and fire. The wax and the wick twine together like Father and Son, the fire proceedeth from them both, and of the Three or the One comes the light that serves laborers to see by. It is doubtful whether any of these illustrations are Langland's own.

God. The attributes and function of each Person of the Godhead are specified in connection with the above illustrations, and elsewhere. God as the moral ruler of the universe is Truth. As its creator and physical ruler, He is identified with Nature, or Kynde (C, XI., 151). At the close of the poem, Langland seems for a time to have separated his conception of Nature from that of God (C, XXIII., 80); but even there Nature's ravages cease as soon as men amend, and the agency of God is still apparent (Ibid., 109).

God created man, endowed him with the Holy Spirit, and adapted the earth for his occupancy (B, IX., 33-47; C, II., 17 ff.). God is without beginning, the founder of all things in heaven, having established the orders of angels (C, II., 104). He is the fountain of power and justice, yet commissioned the Son and Spirit to open to men the gates of mercy (C, XX., 111-134, 168-209). His throne upon earth is the heart of man (C. VIII., 254 ff.); he has closed within the castle of the body the soul, which is betrothed to him (C, XI., 132), and has established conscience as a ruler and guardian of the castle. By sin He is concealed from man, as the sun by the clouds (Ibid., 160).

The Holy Spirit. The especial attribute and name of the Holy Spirit is Grace (C, XIX., 52). The Holy Spirit is the Comforter of the holy. As the palm directs the fingers, the Holy Ghost was the Inspirer and Director of the Son upon earth (C, XX., 116).

> The palm is purely the hand, and hath power of himself
> Otherwise than the closed fist, or workmanship of the fingers,
> For the palm hath power to put out the joints
> And to unfold the fist, for to him it belongeth,
> And to receive that the fingers reach, and refuse if him liketh,
> All that the fingers and the fist feel and touch,
> Be he grieved with their gripe, the Holy Ghost lets fall. (C, XX., 140).

When the palm is hurt the hand is useless; a simile which hints at the unpardonable sin (Ibid., 161). If the palm be unhurt, one may help himself, though the fingers ache.

The Holy Ghost converts the power of God into mercy, and the mercy of Christ into forgiveness where repentance is, and there only; otherwise it is ineffectual, as a spark struck from flint and steel, without matches prepared to receive it. It directs men on the road to

Truth (God) after repentance (C, XXII., 213-228), and besides, teaches them wit and craft, love and humility.

Christ as Piers Plowman. Christ is mentioned in the poem under two different aspects; in his own proper personality as the Son of God, as in the illustrations already given; and in His human personality as Piers Plowman. Piers is at first a simple plowman, unmistakably such; and at the close of the poem he takes on as unmistakably the character and attributes of the Son of God. But the author has accomplished the transition in a very rude and imperfect manner, full of inconsistencies and contradictions, which he apparently perceived but was unable to remove.

At first the plowman is introduced to show that real knowledge of Divine things is found rather in the humble than in the learned, whom Pride may have turned from the right way. To make the beginning still more simple, it is not Grace that teaches Piers, but the secondary ministers, Conscience and Kyndewit (C, VIII., 184). The allegorical way that Piers points out leads past the various landmarks of the Ten Commandments, to a court or castle, whose moat is Mercy, the wall Wit, the battlements Christianity, and the buttresses Believe-and-be-saved. Within, the houses are roofed with Love and Leal-Speech. The bars are of Obedience, the bridge is Pray-well, each pillar is of Penance and Prayers to Saints, the hooks that the doors hang on are Alms-deeds. Grace keeps the gate; his servant is Amend-you, and at the postern gates the porters are the seven virtues.

He who points out this short and easy way to a Celestial City older than Bunyan's, is at first only a simple hind; but he soon begins to assume something of authority, in response to the request that he act as guide. In yielding to this request, Piers begins to reveal the second and most important aspect of his character, that of teacher. He may not go as guide until he has finished plowing his half acre; and that he may finish the sooner, the seekers after Truth set to work to help him. Yet in this passus (C, IX) it is Hunger rather than Piers that exhibits some of the attributes of Christ, and after Piers makes his will, Hunger himself becomes the teacher, and advises Piers as to the proper manner of managing the many worthless among his laborers. Here Piers is again merely a plowman, but a man in authority over his half acre, like a head harvestman.

In the next passus, Truth sends to Piers, forbidding the proposed journey; but sends him a pardon for himself, his heirs, and his servants. This pardon is interpreted with reference to several classes of men, until finally a priest questions both pardon and interpretation, and a dispute is the consequence. Here is a new phase of the development. Piers is not made one of the clergy; but in giving him

the power to pardon, Langland introduces the idea that pardon may come to the humblest without the mediation of any human instrumentality; and also that the humblest may serve as an acceptable minister of Truth to others, if his own life be true. Finally the lesson of this passus, which is the focal point of the entire poem, is summed up in this; that while the pope has the power of pardon, and penance and masses avail to save souls, better than all and surer than all is Dowel, a humble and godly life; and he who lives such a life has not only pardon for himself, but may secure it for others. Thus by implication, Piers Plowman becomes a minister of Christ, and another step is taken in the development of the character.

But a new conception of Piers entered the mind of the author as he proceeded to expand in Text B his first answer to the question, What is Dowel? After expressing this conception, he discovered that he had not made it consistent with that already given, and made an effort to reconcile the two in the latest revision of the poem, but without entire success. The next reference to Piers Plowman occurs at the dinner where Will, the author, in his search for Dowel, comes to table with Reason, Clergy, Conscience, and Patience (C, XVI.; B, XIII). The author is thinking of Piers as Christ, but seems to confuse in him no fewer than three different characters. He says of him that he "sette alle sciences at a soppe saue loue one" (B, XIII., 124), a remark that was made by Study (B, X., 206), though of course based on the teaching of Christ. In the same passage (B, XIII., 123), Clergy says "one Pieres the Plowman hath impugned us alle;" but (B, X., 442) it was Will, the author, that impugned Clergy, though his words were again taken from the teachings of Christ, and were in this case directly ascribed to Him. Lastly Piers and Christ are mentioned in successive sentences, as though they were intended to be separate characters (B, XIII., 132-133). Here then are confounded in a few lines, Christ, Piers Plowman, Study, and Will himself, though the author's general meaning is clear. But in view of these facts it can hardly be said that the identification of Piers Plowman with Christ is, as yet, by any means direct or complete.*

Langland next speaks of Piers Plowman as possessing the power to read men's hearts, and help them to be charitable or to love one another (B, XV., 190); yet here, while he is undoubtedly thinking of Christ as Piers Plowman, he carelessly keeps the two characters apart by referring to Christ by name in the preceding line (189). Finally he settles for us the question as to what his meaning really is,

* In B, XIII., 237, the priest bids the people pray for Piers Plowman: and in C. XVI., 195. Haukyn is Piers Plowman's prentice. These references balance; the first seems to contemplate the human side of the character, the second the divine.

by saying in so many words, albeit in Latin, that Piers is Christ (B, XV., 206), "*Petrus, id est Christus.*" But we are not allowed to rest in this assurance; for in a short time we find them again separated, almost hopelessly. In Text B, Piers Plowman appears to Will in a vision, describes and explains to him the tree of Charity or True-love, and states that it is to save the fruit of this tree, Piers Plowman's fruit, that Christ is commissioned. At first nothing here interferes with identification, but finally we come to the statement (B, XVI., 104) that after the birth of Christ, Piers acts as His teacher.

Langland evidently perceived the inconsistency, and attempted to remove it. In the C-text, the references to the words of Piers Plowman (C, XVI., 131)* are made somewhat more general, and less suggestive of other characters. However he makes matters rather worse instead of better by introducing into the allegory Piers' sudden and mysterious appearance at the dinner, and his equally sudden disappearance, accompanied by Reason. Here Piers utters in person the words elsewhere ascribed to Christ (C, XVI., 138) and makes use of miraculous power. From this we might conclude that Langland aimed to make unmistakable the divinity of Piers; but he again puzzles us by omitting the formal statement that Piers is Christ. But though he omits this formal statement, he removes another inconsistency, by ascribing the whole of the action of the passus (B, XVI.) to Freewill instead of Piers Plowman, including the mention of him as teacher of Christ, thus leaving us at liberty to assume for ourselves the identity of Piers and Christ, if we choose to do so.

But still another conception is presented in the twenty-first passus, making it for a time again impossible to regard Piers and Christ as one. In passus XXI. the Plowman reappears in his human character, but with new attributes, gradually growing more like Christ until the end of the poem. In the preceding passus a character is introduced which is named simply the Samaritan, but which is conceived as Christ in the flesh (not the conception just discussed), as is shown when in Passus XXI. Christ appears in person, and it is explained that he wears the armor of Piers Plowman, and resembles the Samaritan. Here reappears the idea mentioned in B, XVI.; in both texts it is stated that Jesus comes to joust with the foul fiend to redeem the fruit of Piers the Plowman. We begin now, as it would be perfectly consistent to do had no mention of Piers been made since Passus X., with two persons, Christ himself, and Piers Plowman, his humble servant or minister, whose armor Christ wears. In the armor of Piers, that is, in the body of man, the life of Christ is

* Parallel with B, XIII. See p. 252.

described; then his apocryphal visit to hell, whence he brings the souls of many. At last (C, XXII) the author sees Piers Plowman "peynted al blody," resembling in all things our Lord, and asks the question point blank, Is this Piers Plowman, or is it Christ? Conscience answers, It is Christ with his cross, conqueror of Christendom.

Not yet, however, is it necessary to make the identification absolute; we still have Christ in the armor of Piers, and Piers is still the servant whose armor Christ wears. Piers is now more formally endowed with the functions of the clergy; he receives from Christ the power to forgive sin, and the gift of the Holy Spirit. He is commissioned by Grace, the Holy Spirit, as procurator, reeve, and registrar, to receive debts due. As a purveyor and plowman upon earth, with a team consisting of the four gospels, and another of the four fathers, Austin, Ambrose, Gregory, and Jerome, he receives, for sowing, the seed of the four cardinal virtues, and is ordered to build a barn to contain the harvest. The barn finished, Piers goes forth through the world with Grace, to cultivate Truth. While he does this, his friends and neighbors are attacked by the host of Anti-Christ; and the laborers flee into the barn, Holy Church, where under Conscience they attempt to defend themselves. At last the enemy through treachery obtain entrance to the barn, and secure such an advantage that Conscience girds himself to go forth and bring Piers Plowman to the rescue. Here the poem ends, and it is this last reference that seems again to make Piers Plowman one with Christ.

To the question, therefore, Who or what is Piers Plowman? no consistent answer can be given, if we attempt to reconcile all the various interpretations, or if we attempt to reconcile all three texts with each other. In one case, Professor Skeat, for instance, interprets Piers to mean the pope, bishops, the whole church, Christ, and the clergy, in almost as many consecutive lines of C, XXII. Again, we have to reconcile the author's own statement that Piers is Christ, with his equally plain teaching that Piers is a servant of Christ.

The interpretation of the character of Piers that seems to reconcile more discrepancies than any other is this: Let Piers Plowman denote man endowed with the spirit of Christ, or human nature in its highest form (Skeat, Notes, p. 250), until the end of the poem is reached, and Conscience sets out in search of him. Then and there he may be assumed to take the character of Christ, but in this place it may be regarded as a natural climax, and a fitting conclusion to the whole. If this interpretation be kept in view, it does not matter whether Piers be understood in special instances to mean pope (B,

XIX., 424; C, XXII., 428), bishop, or plowman. It will however be necessary to reject Professor Skeat's explanation of these lines (C, XXII., 213):—

"Tho by-gan Grace to go with Peers the Plouhman,
And consailede hym and Conscience the comune to someny;"—

the summons being in order that the commons may be provided with means of livelihood, and of defense against Anti-Christ. Of this passage Professor Skeat says (Notes, 268), "Here Grace is the Holy Ghost, and Piers the Plowman is still Christ; the latter title not being used of Christ's deputed successors till line 258 below, though the name of *peers* has been once so used above in line 188." But there can hardly be a distinction between "peers" and Piers the Plowman, particularly as the "peers" of line 188 appears in the preceding line (187) at full length as "Peers the Plouhman." The special gifts that are afterwards mentioned proceed from the Holy Spirit, not from Piers. Moreover, at the next mention of Piers, Grace calls him "my plowman upon earth," a statement fully as consistent with his humanity as with his divinity.

That objection to the suggested interpretation, which is based on the account of Piers Plowman at the dinner (C, XVI., 138), cannot be disposed of, unless we call the passage a blunder on Langland's part. Here he certainly means Christ and as certainly calls Him Piers Plowman; but a reason for doing so, other than that suggested, is not apparent.

We have remaining, after the passages mentioned, the final reference to Piers Plowman as to one who alone can save the church. This reference does make him Divine; but for this exaltation of his character we are now fully prepared. Piers, with the exception mentioned, has been taking on more and more of the Divine character without merging in it the human, until at this point, with a single touch, he is uplifted and glorified; and he who has hitherto been a fellow laborer and a fellow sufferer as well as a guide and teacher, suddenly, yet naturally, in a moment of deepest despair, becomes a Savior. Thus a light still beams; and the darkness in which the poem ends is not absolute, nor hopeless, but may be the darkness before the dawn.

Christ the Son. I conclude then that the conventional interpretation of Piers as Christ must be accepted as the conception which was undoubtedly in the author's mind when writing a certain part of the poem; but that in revision, he weakened the conception of Piers as Divine and strengthened that of Piers as man endowed with the Divine Spirit, thus bringing into greater harmony the several parts of his poem, but not completing the unifying process. To support this

conclusion, there is constant reference made throughout every part of the poem, to Christ in His own proper person as the Son of God, proving that to Langland Christ and Piers were ordinarily separate conceptions; and these references are as numerous or nearly so in those passages where Piers is most often mentioned, as elsewhere; "Christ" and "Piers" often standing side by side in consecutive lines.

From the references to Christ in his Divine personality may be gathered a tolerably complete life history and doctrinal teaching. In C, XIX. and XXI. are given the fullest accounts of the life of Christ, the first incomplete, the second much condensed. The first includes the incarnation, miracles, and betrayal; the second begins with Christ's last journey to Jerusalem, describes His trial and crucifixion, His descent into hell, and triumph there.

The martial and chivalric spirit of the Middle Ages appears, in that Christ rides to enter Jerusalem as a knight in armor to a tournament (C, XXI., 14). When He hangs upon the cross, none dare touch Him to wound, because He is a knight and a king's son; hence at last, the blind Longinus, himself a knight, is called on to deal the fatal blow, unwitting who his victim is. The blood streaming forth restores to Longinus his sight, whereupon he kneels to ask forgiveness of Christ, and by this act, as he is the Jews' champion, he yields to Christ the victory, and places the Jews at His disposal, according to the law of arms.

In C, XXII. Christ appears to Thomas, and ascends into heaven, deputing His power upon earth to Piers Plowman. Further we find His commission from the Father, and His forgiveness of His slayers (C, II., 164–168), the creed of the atonement, crucifixion, and redemption (C, VIII., 121 ff.), His relation to man as father, brother, savior (Ibid., 144), the power of His love to move and direct men (C, II., 149 ff.), the necessity of belief in Him as the Son of God (C, XII., 142 ff.) His poverty (C, XIV., 1-4) and especial love for the poor (C, XII., 292), and His all-embracing mercy (C, XII., 254 ff.).

Mother of Christ. Though the central figure in Langland's theology is Christ himself, he recognizes in accordance with the teaching of the church, the dignity and authority of His mother. She is frequently invoked by name (C, III., 2), or as intercessor with the Son (C, VII., 170). It is stated in Latin and again in English (C, VIII., 250–289) that she, under the name of Mercy, has a key to heaven, that both she and her Son may grant help to the sinful, and that there is no other help but through those two.

Heaven. The poem contains no picture of heaven, but only occasional references and suggestions. It is variously located, sometimes toward the east, from the point of view of the stage of the Miracle

Plays, and sometimes toward the south, from the traditional point of view. As to constitution and government (C, II., 104 ff.), there are among the angels ten orders of knighthood, and we may conclude that the multitude of the redeemed are the commons, and that among them there are degrees of bliss, for the thief who repented upon the cross (C, XV., 132) is not seated with the saints and martyrs, but upon a far lower level.

Purgatory. Langland believes with the church that souls repentant, but who have not made full restitution (C, XIII., 65: see topic Penance) may be purified in purgatory, and that the prayers of the good, masses, and special services avail to lighten their punishment. To sing at such services was his own employment (C, VI., 46). Good deeds enable kings and knights to pass purgatory easily (C, X., 9). Those who take bribes shall yield them again at one year's end, in a full perilous place called purgatory (B, VI., 42). The patient poor pass purgatory sooner than the rich (C, XIV., 31), and through perfect faith, one may pass purgatory penanceless (C, XII., 296).

The Evil Spirit. As was the contemporary belief (Skeat, Notes, 258), to Langland Lucifer is the chief of the fallen angels, the Prince of Hell, while Satan, the Duke of Death, is merely a subordinate under Lucifer. Chaucer (Monks Tale, line 14) applies the name Sathanas to Lucifer after his fall. In the passage where Langland introduces both (C, XXI., 262 ff.) Professor Skeat points out that there is some confusion in their traditional characters, since to Lucifer and not to Satan is ascribed the temptation of Eve (C, XXI., 315). But the characters are clearly differentiated. Satan counsels armed resistance to the approach of Christ; Lucifer knows this to be vain, but in his turn would meet Him with a legal plea, which Satan perceives to be useless. Subsequently Lucifer's subordinates accuse him of having lost to them their joy in heaven, and now through his deception of Eve the lordship of hell is also to be forfeited. For this deception Lucifer is bound, while the rest flee and hide.

Lucifer was formerly a member of the chief order of knighthood in heaven (C, II., 105). Believing that he was wittier and worthier than his Master (C, VI., 188), he sought to establish a kingdom for himself in the north part of heaven (C, II., 112) but on his way thither he failed and fell, and all his fellows; some in earth, some in air, some in hell deep — Lucifer lowest of them all, though still retaining his leadership.

Why Lucifer sought the north is a question Langland declines to answer, that he may spare the feelings of northern men (C, II., 105). We might take the statement (Ibid. 134) that active men need no

fire except on a holiday, as a hint that Lucifer's idea was to establish a kingdom in a country where the climate would compel his followers to be active and agressive, and hence would insure stability of government. But Professor Skeat states that the conventional explanation (Piers Plowman, E. E. T. S. ed., Vol. IV., Section I., p. 35) is that Lucifer's malice in causing other angels to fall from heaven was like the coldness of the north winds that chill the flowers, and hence that the north was the only suitable place for him.

The devil, the same who deceived our first parents, and hence for consistency, Lucifer, though by tradition he should be called Satan, lies in wait for the fruit of the tree of charity, that is for the souls of men at death, and is continually endeavoring to batter them down from the tree. To him all robbers are especially near of kin (C, VII., 330, and parallel passages).

Hell. We have a more complete picture of the infernal regions than of heaven (C, XXI) but still lacking in definiteness. Its location is more confused than that of heaven; it is toward the north in the passage just mentioned, toward the west (C, I., 16; C, II., 55), and toward the east (C, XXI., 19). The first comes from tradition, the second is the position opposed to that of heaven upon the Mystery stage, and the third is probably due (Skeat, Notes, 253) to the position of the mouth of hell upon a separate stage of the same platform.

There are degrees in hell as in heaven. Trajan, because his life was moral, was punished not deep in hell, but so high up that he was delivered thence, and is now in the lowest heaven (C, XV., 150; cf. C, XIII., 75). With respect to the matter of deliverance from hell there is a difference of opinion between Truth and Mercy (C, XXI. 115-157 ff.). Those condemned under the Mosaic law may be delivered through the atonement of Christ, and the example of Trajan proves, in at least one instance, the power of prayer to deliver; but it is not certain that this establishes a rule, since the fate of Solomon, Socrates, and Aristotle is still in doubt (C, XII., 220; C, XV., 192).

b. MAN. DUTIES AND TRANSGRESSIONS.

Place in Creation. The earth is for the habitation of man, and the elements and all creatures are for his service and delight (C, II., 17; B, XI., 389). Man is responsible for a double portion of wit and freewill (B, VIII., 55-56), yet often rules himself less according to Reason's teaching than do the other animals (C, XIV., 192). Men may be classified into three degrees of holiness, the married, the widowed, and the virgin (C, XIX., 71 ff.). He must not seek after knowledge beyond his natural portion (C, XIV., 222 ff.).

General Duties. If the teaching of the whole poem may be reduced to a word, man's duty is to love and labor. The duty of love and benevolence is constantly iterated, and its application is made specific in countless instances; while the duty of labor is the keynote struck in the beginning, and with all the author's power. Labor should be honest, and love should be according to law. For the rest, we may sum up Langland's teaching as that man's duty comprises the observance of the four cardinal virtues, and the avoidance of the seven deadly sins through the cultivation of their opposites (See C, XXII., 274; also C, VI. and VII). Langland places especial stress upon temperance, economy, humility, honesty, and truth.

Active and Contemplative Life. Attendance upon divine service upon Sunday is obligatory upon all (C, X., 221-245). Langland believes in all the observances of the church, but good works towards one's fellowmen, and faith, are of even greater value (C, II., 170-181; C, XII., 142-148). And one observance of the church, that of receiving windows commemorating the giver, he disapproves in toto, and gives warning that good deeds are not to be published (C, IV., 63-76). There are two kinds of life that are acceptable to Christ, the active and the contemplative; and both are blessed if lived in accordance with the law of God (B, VI., 249 ff.). To the contemplative life belong prayer and the observances of the church, but it must be lived in self-sacrifice, not self-seeking (C, II., 170-181); one may know Christ neither through words nor works, but through will alone (B, XV., 204). The active life may also be abused, as it is by Haukyn (C, XVI., 194 ff.), who finds the task of providing for his temporal wants so great that he lacks time to care properly for his own spiritual life; but if lived in faith, love, temperance, and humility, it is worthy and sure of heaven (B, XIV., 46-58). In another sense, the married life is active life, and widowhood and virginity are two degrees of the contemplative life (C, XIX., 71-83). The latter is perhaps the holier, if worthily lived.

The Poor. Langland, though he realizes the sins and short-comings of the poor, provides them with all the consolation in his power, the conclusions of his philosophy of life. Since they suffer so much in this life, they shall surely be rewarded in the life to come, if they are patient under suffering (C, XIII., 194). Thus the equipoise will be restored; having winter here, they will have summer in heaven (A, XIV., 160), and may claim heaven as it were by right (C, XVII., 57, 103). The blessings of poverty in this life are also fully discussed (C, XIII., XIV., and XVII.; and B, XI). The poor are not in danger of enemies as are the rich; the sins of pride, gluttony, and

so on, can obtain no advantage from poverty; adversity teaches one to look to God for help (C, XVII., 95); to forsake possessions is to become kin to Christ. Poverty (C, XVII) is hateful to pride, has not to sit as judge, and is thus freed from care, is not troubled with evil winnings or appeals to lend, is temperate and defends the flesh from sins, gives health and strength, lives in peace, is wise, truthful, not covetous, a true laborer, does not overcharge, is the comfort and solace of the soul. Such is Langland's interpretation of a passage from Vincent of Beauvais.

The Rich. As obverse of this picture, we have the rich, doomed to suffer in the next world for their joy in this, unless they have recourse to confession, contrition, and satisfaction. The rich are wasteful (C, I., 24), often dishonest, and, in that case, should not be entitled to the freedom of any city (C, IV., 112). They keep at their tables idle and worthless minstrels and jesters, to the neglect of the worthy poor (C, X., 128); and indulge there in idle disputation and infidel conversation (C, XII., 35). They are loved only for what they possess, and their giving is less pleasing to God than is the patient endurance of the poor (C, XVI., 282). They must beware lest they be condemned as Dives was, for sins of omission (C, XX., 228).

King. As already noted (page 244), the political duties of the king are founded upon the moral law. He must be generous (C, IV., 266), love the commons, his treasure (C, IV., 181), defend holy church (C, X., 12), and rule according to Dowel, Dobet, and Dobest (C, XI., 100), being accountable to Dobest. The meaning of the famous prophecy (B, X., 317-330; C, VI., 169-180), is doubtless that through a king, by virtue of his royal power, is the sole hope of reform in the church.

Knights. The true knight owes his faithful tenant kindness and fair speech, should take no bribe, be courteous, be no hearer of tales (C, IX., 19-53), dispute not conscience, or the rights of holy church (Cf. page 244).

Pope. There are many traces of an independent and critical attitude toward the head of the church, especially since there were in Langland's time two claimants of the position; and this independence of attitude seems to increase in later versions of the poem. Though in Text A (VIII., 8) he has spoken of the pope's pardoning power, in the parallel passage he transfers this power to Truth. But this power is again ascribed to the pope (C, X., 324) and the pope is undoubtedly meant (C, XXII., 188 ff.) where Piers Plowman is said to have the power to bind and unbind, and assoil of all sins save the failure to make restitution.

Haukyn complains (C, XVI., 217 ff.) that for his support of the pope, he has received nothing in return (Cf. B-text), and wishes that the pope might subdue the pestilence, not daring to impute his failure to a lack of power or holiness in the pope himself, but ascribing it to the sinfulness of men upon whom the pestilence is sent. The schism of the popes probably gives rise to several allusions. No wit or strength of this world can make a peace between the pope and his enemies profitable to both (C, XVI., 173). It is wrong for the pope to pay men to make war upon other Christians, and the ways of peace are preferable for the good of the church, and of Christ's kingdom (C, XVIII., 234). Imperfect is the pope that all people should help, and sendeth them that slay such as he shouid save (C, XXII., 430).

Cardinals. As the most virtuous virtues are the cardinal virtues, cardinals should be most virtuous of men, and doubtless are so (C, I., 134). But a certain ignorant vicar, who has already impeached the pope, doubts this (C, XXII., 411-425), and looks upon cardinals rather as sources of all evil. Coming from Rome to bring messages and collect moneys, they are sources of great expense, lechers, and a curse to the country they come into.

Bishops. The principal charge, among many, against bishops, is that they seek sloth and ease, neglecting the care of souls, and are particularly careless of the command of Christ to preach the gospel to all nations; hence so-called bishops of foreign lands maintain residence in London or Rome, and never think of going elsewhere (C. XVIII., 187). They should be learned, wise, and holy; fearless in reproving sin, living as they teach. They are the rulers and judges in the church, and with the apostles may act as judges at domesday (C, X., 13-21). Their punishment will be according to their responsibility if they fail (Ibid., 255). But poisoned by the gift of lands as the church is, its bishops seek only for lands and money (C, XVIII., 220); often they purchase their positions (C, VI., 70), are ignorant of their duties, and allow their subordinates to deceive the people with false teaching, false miracles, and the sale of relics, images, and indulgences (C, I., 66-100).

Parochial Clergy. Upon the parochial clergy and friars, Langland expends all his energy and indignation. As with the bishops, the root of all is neglect of duty and eagerness for money. They leave their charges to seek silver in London, allow traveling pardoners to preach to their people, and divide with them the profits of the sale of indulgences or pardons. Often they are unchaste, proud, slothful, and ignorant. When pure, they often lack charity. As a complete antithesis to Chaucer's parson, nothing better could be

found than the character of Sloth (C, VIII., 1-67; cf. B. X., 306-309). They quarrel constantly with the friars over the profits of confession (C, VII., 119–129), and live as wolves among their own sheep (C, XVII., 241–278).

Priests who dwell in cities should be attached to some church (C, VI., 89). They should desire poverty as the more blessed condition, and, apparently, Wyclif's "poor priests" are commended (C, XIV., 101) while the spirit of the new movement is further approved in that Langland commends translation of the Bible (C, XI., 88). Priests should be created for their learning, and should be free born. But learning without the Spirit of God is emptiness; such clergy are easily turned from the faith; while the ignorant are always blind leaders of the blind. They may be lost, as were the builders of the ark (C, XII., 250), having their reward in this world, and forfeiting it in the next (A, III., 237). A priest must suffer all things, and pass by riches, wine, and women (C, XII., 103–118). Passus XVIII. gives one of the strongest pictures of what a perfect priest should be, in contrast with the depth of infamy to which many have fallen.

Priests may take no tithes of evil men, else they shall be punished in purgatory (C, VII., 300). They must be faithful to the minutest details of duty, and even "overskipping" in reading the services is a fault so serious as to be twice condemned (C, XIV., 119; XVIII., 118). Langland utters a point-blank denial of the general assumption of priests and monks that to them is due the first and best of everything (C, XVIII., 58–63):—

> Help thy father first before friars and monks,
> And before priests and pardoners, or any people else.
> Help thy kin Christ bade, for there beginneth charity,
> And afterward await who hast most need,
> And there help if thou hast, and that hold I charity.

Clergy as Scholarship. Clergy means scholarship as well as priesthood. The advantages of Clergy are pictured in Passus XV. It has skill to confound its adversaries, makes record of the truth, teaches, and leads to salvation. Untaught men have a learning of their own, but it saves not souls; it is but knowledge of birds and beasts, and is folly without the Divine Spirit (C, XV., 72). Even a single line of Holy Writ in the memory has power to save a thief from the gallows (C, XV., 129). The clerk may protect himself and others; if he err, he destroys all faith of those about him, but if he does well, his followers do better (C, XVIII., 122).

Friars. The four orders of friars of which Langland usually speaks were the Eremite or Austin friars, or Augustines; the Carmelites, or white friars; the Dominicans, or Jacobins, or black, or preaching friars; and the Franciscans, Minorites, or grey friars. The fifth

order, mentioned in the C-text, was probably that of the Trinity friars. crutched friars, or crossbearers (Cyc. Brit., IX., article Friars; Skeat, Notes, 9). For a description of the friar at his best, we should turn to the description of Charity (C, XVII., 297 ff.), though that description includes more than the friars alone. Charity rejoices with the glad and mourns with the sorrowing, fears no sickness or hardship, has no property and cares for none, goes on pilgrimages to the poor and those who are in prison, yet is merry at meat, and very good company. But finally we are told that he was found but once in a friar's frock, and that many years ago, in St. Francis' time.

For love of money friars too forsake their rules, trespass upon the parishes of the clergy to confess those afraid to confess to the priest who knows them best (C, XXIII., 286; C, IV., 38). They quarrel with the secular clergy, and among themselves; glose the gospel to suit themselves (C, I., 58) and for money pervert the teachings of better men (C, VII., 118), thus weakening the faith of man (C, XII., 54–60). For money they pardon the gravest sins, and prefer always to administer those offices of the church to which a fee is attached (C, IV., 38, B, XI., 65). They admit rich men to the privileges and benefits of their order by means of letters of fraternity, without requiring of them any self-denial or vows, or aught else except liberal payments (C, XIII., 4–11; Skeat, Notes, 130). They are entitled to help and support only when they ask humbly and for what they need (C, IX., 146). But instead of asking humbly, they claim the best seats and the best food, vaunt their own holiness (C, XI., 18), and preach best when full of wine, even on the subject of temperance, and at the same time exalt the virtue of doing as one preaches (C, XVI., 65–127). They love to deal with idle matters, and those above the comprehension of the people (C, XVII., 230).

To sum up (see C, XIII., 230 ff.), they are welcome in holy church so long as they live after their rule and the example of the founders of the orders, and keep their numbers within reasonable limits. But their undue increase in number, their false philosophy, their shriving of the guilty without due penance and restitution, will lead to the destruction of themselves if not of the church; and the Flatterer who poisons the defenders of the church, and drives Conscience forth into the world to seek the aid of Piers Plowman, is a friar.

Hermits. Hermits no longer live like the early anchorites (C, XVIII., 13–36) but have their cells in public places, and wander abroad like friars and recreant priests (C, I., 51). Even more against them than the friars is the charge laid that they have chosen a life nominally religious to avoid labor (C, X., 188–254). In the life of

Pilgrims and Palmers. the pilgrims and palmers there seems to be nothing even nominally religious, except the pilgrimage itself, which Langland is disinclined to accept as a religious observance. Their leave to lie (C, I., 48) if not granted by the Pope, existed by common consent; and in another sense, a palmer, notwithstanding all his journeying, had not the remotest conception of the way to Truth.

Nuns. There is quarreling and unchastity even in the nunneries; a statement with which Gower is in accord (Morley, E. W., IV., 187). Langland approves the ordinance of Gregory that women shall not be admitted to the priesthood (B, V., 166; C, VII., 132–150).

Lollers. Partly in the church and partly out of it belongs the class of idle vagabonds, *lollers*, of whom are many hermits and pilgrims, besides many who think neither of hermitage nor pilgrimage. Langland resembled these, although they thought little of him (C, VI., 1–4). The growing tendency to apply the term to those who held and practiced new doctrines, or peculiar theories of life, is apparent in the poem; but the formal definition of it as given by Langland is as follows: (C, X., 215)

> "He that lolleth is lame, other his leg out of ioynte,
> Other meymed in som membre, for to meschief hit souneth (hinteth)."

But he himself applies it to a certain class lame only in a metaphorical sense,—

> "And ryght so sothlyche such manere eremytes
> Lollen aȝen the byleyve and lawe of holy churche;"

showing that there was a general appreciation of the similarity between the idle beggars of the church; and the idle beggars who lay by the wayside, and feigned themselves wounded, crippled, or diseased.

Merchants. The especial charge against the merchants is, of course, that of deceitful dealing (confession of Avarice, C, VII.. 196 ff.); but the dignity of their occupation is recognized, and they are bidden to buy and sell, and use their winnings in specified works of charity (C, X., 22 ff.; see also C, III., 222; C, IV., 112). The dangers and uncertainties of their business are also hinted at (C, VII., 278; C, IV., 33).

Lawyers. Lawyers, the term including political officials of all sorts, are particular friends of Lady Meed, and there is not one from the highest to the lowest who does not woo her. These are liars, lechers, brokers of evil, malicious prosecutors, extortioners, shielders of the guilty; they allow prisoners to escape either by opening doors, or by buying off the prosecutor, at the same time appealing to his sympathy, as was done in the case of Wrong (C, V., 45–65). Thus did many a bright noble baldly bear adown the wit and wisdom of West-

minster Hall (C, XXIII., 132); and it also appears that bright nobles could make "leal matrimony depart ere death come," and shape divorces (Ibid., 139).

The fullest enumeration of the evil deeds of judges and counselors is found in Richard the Redeless (III., 317–345), but probably has reference to the special abuses of a particular time. They foment quarrels, prolong cases, bring false charges, give judgment before giving evidence, and endanger the lives of those who complain. Magistrates share in the general corruption under Meed (C, IV., 109).

As toward the king, magistrates should judge justly, and as toward the people should impose fines and punishments in love and kindness (C, II., 157). All counselors should seek Truth, not gold or gifts B, V., 53); and should give advice free to those who cannot afford to pay (C, X., 44–57; B, VII., 39–58).

c. DOCTRINES OF HOLY CHURCH.

The Church. The source of the church is the Trinity. She is a lovely lady descended from the castle of Truth (C, II., 4). In one passage she calls herself the daughter of Christ and duchess of heaven (C, III., 31); while in another is conveyed the more conventional idea that the church is the bride of Christ. More interesting than these is the account of the church as the barn of Piers Plowman, which becomes the church militant when assailed by Anti-Christ, where Conscience is commander, and Peace gate-keeper. Meed is the bitter enemy of the church. The church has been poisoned by the endowment of lands (C, XVIII., 220). From foes without, and unworthy servants within, she has come to low estate, and needs to be clothed new (C, VI., 180), but this is misfortune, not fault. Her law is charity (C, XVIII., 124), belief, loyalty; and she is a refuge for all men, except the evil who have not forsaken their wickedness (C, XI., 76). She is the custodian of the bodies of men after death (C, IX., 100); the guardian of the sick and helpless (C, IX., 138), of those that lack full understanding, of fatherless children, poor widows and helpless maids (B, IX., 66). Sponsors in the church must see that their godchildren walk uprightly (B, IX., 74).

Sin. The chief auxiliaries of Anti-Christ in this world are the seven deadly sins, of whom, if any distinction may be made, Langland seems to regard Pride, Avarice and Gluttony as chief; judging from the fullness of his descriptions (C, VII. and VIII.). Gower's treatment of this subject (Confessio Amantis) is more complete and formal than Langland's. His list includes all the subordinates, as follows:

1. Pride; hypocrisy, disobedience, presumption, boasting, vain glory. 2. Envy; grudging of good fortune, gladness at grief, de-

traction, dissimulation, supplantation. 3. Wrath; melancholy, chiding, hate, contest, homicide. 4. Sloth; delay, pusillanimity, forgetfulness, negligence, idleness, somnolence, despair. 5. Avarice; jealousy, cupidity, perjury, usury, parsimony, ingratitude, violent seizure, robbery, secret theft, sacrilege. 6, Gluttony; drunkenness, delicacy. 7. Lust.

Langland's order is: pride, envy, anger, lechery, avarice, gluttony, sloth; and his treatment has life as well as simplicity. Each sin is represented by a single penitent, with the exception of Pride, which has two exponents, and the personal appearance of each is as fully portrayed as are the various forms of misconduct in each. If the confession of each be followed through in detail, it will be found that Langland has in mind probably an exposition similar to that of Gower, but is treating it with his usual freedom.

The picture of Glutton is most lifelike of all. That of Sloth is only less so; he is a fat and greasy country priest, ignorant, careless of duty and offices, riding to hunt, denying debts, and cheating his servants. Through Sloth we may trace a way to the unpardonable sin. Sloth leads to despair, and the branches that lead men to sloth and despair are (C, VIII., 70), lack of sorrow for sin, neglect of penance and almsdeeds, living against belief and law, neglect to study; all of these cause man to doubt the grace of God, and hence prevent him from repenting and calling for mercy. Yet all sin may be forgiven if there be contrition (C, XIII., 71); and sorrow of heart is satisfaction for such as may not pay otherwise (C, XX., 296), though restitution and good works should be added if possible. The unpardonable sin, the sin against the Holy Ghost, has many forms, but the chief is to slay an innocent man, a follower of Christ (C, XX., 260-296). Even this slayer might be pardoned did he not despair of obtaining mercy and hence fail to repent. Hence Sloth, which leads to despair and disbelief in the power of God, is one of the most dangerous of the deadly sins,

Salvation. How then may I save my soul, asks Will (C, II., 80). Holy Church answers, Live in truth and love, be true of tongue and hands, do good works therewith, and do no man ill. If one's intent and effort be true, there is pardon for failure (C, IV., 350). To remove the stain of actual sin are repentance, penance, and faith (C, IV., 401). These place men in a right relation to God.

Salvation is of grace, not works (C, XII., 254-271), and grace may be withdrawn (C, VIII,, 283 ff.); yet there is merit in good works if they be inspired by love and a sincere devotion to the idea of right, as is taught by the story of Trajan. Faith without works is inefficient and may fail to save (C, XIII., 92 ff.). And faith and good works

do not save without the Atonement of Christ (C, VIII,, 121; C, XX., 81); those who died under the Mosaic dispensation awaited in hell the coming of Christ as their deliverer.

The prayers of the righteous for those still upon earth (C, IV., 98) avail to save souls from purgatory, and in the case of Trajan the prayers of a most holy man delivered him from hell itself, a result due to his just life as well as to prayer. But Solomon, Socrates and Aristotle are supposed to be still in hell (C, XII., 220). However Langland expresses some doubt of the traditional belief, and reasons that since a just man shall *hardly* be saved in the day of judgment, it therefore follows that he may be saved. A true man that lives as his law teaches, and believes that there be no better, or would have kept it if there were, and lives and dies in that will, for him there certainly is commendation, his faith is great, and hope of reward depends upon that faith (B, XII., 268-293; C, XV., 192-217).

One may sin often and yet be saved, as one in a boat may fall within it and be in no danger (C, XI., 30). The salvation of the ignorant may be more easily accomplished than that of the learned; but those who are saved late or narrowly may not expect a high place in heaven (C, XV., 92-145).

Christ may not be renounced after full acceptance, but neglect of duty to Him will be punished in purgatory until all arrearages are made up (C, XIII., 53-70).

Baptism. To be baptized is the command of Christ (B, XIV., 183), and children are not saved without it (B, XI., 82). It washes away all sin, and is the pledge of salvation (B, XIV., 181-190). There is a baptism of font, of blood, and of fire (C, XV., 207). It should be administered by a Christian only, except among the heathen, Saracens and Jews at the approach of death, when an unbeliever may perform the rite. In such a case belief and baptism are sufficient to save; but ordinarily to belief and baptism must be added fulfillment of law (B, XIV., 345-359).

Confession. Penance, Absolution. If a man sin after baptism, the three steps toward forgiveness are contrition, confession, and satisfaction (C, XVII., 25). Contrition makes deadly sin venial, and contrition and faith may save even without confession. Confession slays the sin; and satisfaction, which may be interpreted penance or restitution, buries it out of sight and makes it like a wound healed (B, XIV., 82-96). It is implied (B, XI., 94) that the secrets of the confessional are to be preserved.

Though Langland formally teaches the duty of penance, he really attaches to it little importance; in fact he satirizes it by making his penitents propose their own penances, and these often apparent

rather than real. Pride will wear a hair shirt, Lechery drink with the duck only, Glutton will eat no fish on Friday, not stating whether he means to abstain from food altogether or substitute roast beef, Sloth will be at church before day every Sunday for seven years, a robber will polish his pikestaff and make pilgrimages. Repentance, the confessor, pays little attention to these propositions; but insists upon restitution, particularly in the case of Avarice; and after that, prayer. If one may not restore his illgotten goods to the owner, he may bear them to the bishop; perhaps another touch of satire. The only pilgrimages that Langland approves are those to visit the sick and unfortunate (C, XVII., 32; C, V., 122); confessors should enjoin for penance, peace, forgiveness, and love, and those that make pilgrimages to Rome should rather seek Truth (C, VI., 195). Yet, after stating that without contrition, confession and satisfaction, prayer, penance, pilgrimage, and writing in windows are all in vain, he admits that with these three essentials, telling of beads, pilgrimages, privy penances and almsgiving are as aids to holiness C, XXII., 377; C, XVII., 29).

Shrift cares for the wounded of Holy Church (C, XXIII., 306). Pardon is sure for those that truly repent and believe and amend, even without human intervention. Power to forgive sins is deputed to Piers Plowman (C, X., 8; C, XXII., 185); yet Piers tears up his pardon and prefers to put his trust in prayer, penance (or restitution), and right living; while the pardon itself proves to be simply the promise that the righteous shall inherit eternal life (B, VII., 111 ff.). True laborers shall have pardon (C, X., 60-68). Patient endurance of poverty, sickness and suffering in this life will be accepted as expiation, at least in part (C, X., 175). In short, while the pope has power to absolve from sin and purgatory without penance, and though contrition and confession should be life long (C, XI., 53), and prayer and penance have power to save, nothing is so sure toward this end as Dowel—right living (C, X., 318 to end).

Dowel, Dobet, Dobest. The key to heaven is therefore not to be found in formal observances of any kind,—

> Be unkind to thy fellow-Christian, and all that thou canst pray,
> Deal, and do penance day and night ever,
> And purchase all the pardon of Pampeluna and of Rome,
> And indulgences enough, and be ingrate to thy kind,
> The Holy Ghost heareth thee not, nor helpeth thee, be thou
> certain (C, XX., 216-220);—

but it is found only in Dowel, Dobet, and Dobest; and having thus suggested the question, What are these? it is not strange that Langland devoted the major part of his poem, if not of his life, to answering it.

Without multiplying references, the general conclusion is that Dowel is to purify one's own life and action; Dobet is to care for the needs of others; Dobest is to act with authority, teaching, leading men toward the right, warning the doers of evil, and evidently involves something of clergy (learning). Hence, while to engage in priestly offices is Dowel and possibly Dobet, it is by no means necessarily Dobest. To apply this to Langland himself, in singing the seven psalms for the souls of the departed he was in accord with Dobet; but in writing the Vision of Piers Plowman he was most assuredly with Dobest. Thus did he carry the gospel among men; a gospel new in its application if not in its underlying principles. Without rejecting or questioning the doctrines of his church, he interpreted them in the light of a "clene conscience," and thus restored them often to their original simplicity and opened the way to the Reformation.

Our Neighbor. Passus X, of the poem may be called the doctrinal passus. One of the most moving and eloquent passages is that defining "our neighebores" (C, X., 71-138) as "the most needy."

Marriage. Marriage between the humble should be undertaken at the will of parents, and the counsel of friends, and then by assent of the parties concerned (B, IX., 112). It is unprofitable without offspring (C, XIX., 222). The law of heredity imposes on every one the greatest care in choosing a mate (C, XI., 233 ff.). There is a time for marriage, and those conceived out of time become false folk and faithless, thieves and liars as was Cain (A, X., 127; C, XI., 202 ff.). Good should wed good, though they no goods have, and those who marry for goods shall lead lives unlovely. Maidens should marry maidens, widowers widows, and every manner secular man may wed; a statement which Professor Skeat construes to include the secular clergy (Notes, 145). We have noted that hasty marriages abounded after the pestilence, and that divorces were not unknown (page 265).

Unbelief. Idle scholastic discussion of matters connected with Scripture (C, XII., 35 ff.) and careless preaching have brought a lack of faith in Holy Writ. Scripture should not be shown to those who love to raise idle questions, and preaching to those whose hearts are not ready to receive is useless. If it were not possible to dispute any of the teachings of Holy Church, if the truth of all were absolutely certain, one means of grace would be lost to man; there would no longer be any faith if faith were certainty (C, XII., 159).

Predestination. If all that Scripture and Clergy teach be true, salvation will be impossible for many (C, XII., 201-223); for they say that man's name is written in the book of life, or else not written,

long before he is born. Perhaps for this reason, Solomon and Aristotle are lost; if they wrought well, and are now in pain, it would be unwise for us to imitate them. Again Scripture teaches (C, XIII., 40-60) that many were summoned to the feast, and only a few admitted. Will thereupon wonders whether he is chosen or not chosen, though he reflects that Holy Church had received him at the font for one of God's chosen. He concludes finally that Christ's invitation is for all who will; that all the world may claim and receive mercy through His blood and through baptism. No wicked man shall be lost but if he will (C, XV., 135); one thief upon the cross accepted Him; and if it be asked why the other did not, no clerk can tell.

Charity. The formal definition of Charity (C, XVII., 297 ff.) was referred to in describing the good friar (page 263). Again (C, XIX) Freewill defines charity as the fruit of the tree of True Love, though before the discussion is well begun charity becomes the tree itself, and man the fruit. It is supported on three props representing the three persons of the Trinity; its blossoms are Kind Speech, its root Mercy, its stem Ruth or Pity, and its leaves the words of the law of Holy Church (Skeat, Notes, 235). Charity, represented by the Samaritan (C, XX., 46) and typifying Christ, saved the wounded man when Faith and Hope had passed by him.

Cardinal Virtues. The four cardinal virtues are prudence, temperance, fortitude, and justice (C, XXII., 274). At the beginning of Passus XXIII. it is said that Necessity, or Need, is superior to all the virtues except temperance; and that in need one may not take counsel of Conscience. One may take meat to save life, when none will give, and the same is true of cloth and drink. Then follows a statement of the deficiencies of some of the virtues. Fortitude is apt to go too far or not far enough; justice has to be guided by the law, and prudence may make mistakes. Then we are told of the virtue of Need. It makes men humble, was chosen by philosophers and by Christ, and will at last turn to joy; so shall one not be ashamed to beg and to be in want. The purpose of this remarkable passage may be to show the weakness of the excuses that have been put forth in the preceding passus by those who fail to observe the cardinal virtues, and to show what is the only valid excuse for a departure from what is commonly reckoned virtue.

Communion. The Holy Communion may be received worthily only after restitution, implying the preceding steps, contrition and confession. As to the Real Presence therein, God's body might not be of bread without clergy (B, XII., 87). One is never right strong until he has eaten the body of Christ, and drunk His blood (C, XX., 87). The blessed bread conceals the body of God (C, XXII., 387). This.

language might have been used by Wyclif, but there is no question as to Langland's simple acceptance of the church's teaching.

4. LANGLAND'S PHILOSOPHY.

Langland's work was intended to have a moral significance only. The efforts of the scholastics had been directed chiefly towards reducing the vast mass of theological doctrine and dogma to something like system. We do not find that Langland is especially systematic; but we do find some traces of scholastic methods, as well as of scholastic conclusions. We might in fact say that the whole of the theological and religious teaching of which an exposition has been given is scholastic, so far as it is systematic and reasoned out in all its parts. But what was scholastic in this respect was common property, and not distinctive of Langland; in fact, in his lack of system and in his belief that it is not possible to give reasons for all one's beliefs, he was decidedly unscholastic. He advances many doctrines theological and doctrines religious, but as to their bearing upon each other he cares little. The curious questions and conceits with which the mediaeval scholastics used to amuse themselves would certainly have been condemned by him (Page 269; C, XII., 35 ff.). But to tell how two persons of the Trinity slew the third is irreverent rather than scholastic; and Langland himself asks many of the questions which used to engage their attention. Of such a nature perhaps are the questions, Why did Lucifer attempt to establish a kingdom in the north (C, II., 112)? Why was the Fall permitted (B, X., 105)? Why should men now suffer for the transgression of Adam (B, X., 111)? If Scripture be true, how can any rich man reach heaven (C, XII., 200)? Why did one thief upon the cross repent and not the other (C, XV., 154)? Are Solomon, Socrates, and Aristotle saved (C, XV., 193)? Are there not also traces of scholasticism, perhaps of sophistry, in the doctor's argument (C, XVI., 172) with Patience; in the discussion between Lucifer, Satan, Goblin, and Christ (C, XXI., 272); and in the argument of Need (C, XXII., 150)? In the latter case Langland seems to adopt as his own the reasoning which he uses; in the other case his attitude is shown by his placing the argument in the mouths of those whom he has already satirized, and by the formal remonstrance which he makes against empty discussions (C, XII., 35). This important passage is made more significant by the fact that the remonstrance is made by Study, and is aimed at her husband, Wit, who has nothing to say in self-defence. Hence we may conclude that exercising speculation without the direction of some safe guide, the Bible or the Fathers, is an indefensible thing.

Scholasticism.

Wit must be directed by Study; Study must be occupied in a proper manner; questions that may not be answered must be passed by; and answers that may not be understood must be accepted on authority, by faith.

Langland's mental habit. Langland thinks too much and too widely not to touch sometimes upon the questions of the physical and mental life of man. For instance, he wonders why man, with his double portion of intelligence, is so prone to make mistakes; while other animals with their lesser portion, always act rightly with reference to their own interests (C, XIV., 143). Yet, recognizing the difference in phenomena he did not for a moment conceive a distinction between instinct and reason, but immediately gave up the whole question, fearing that he was treading upon forbidden ground. But this speculative passage, though it ends in a stinging self-rebuke, shows that his mind is of too high an order to follow a beaten path without thinking what lay beyond it, and deepens our respect for his mental power.

Langland's inveterate habit of personification sometimes leads to apparent confusion as to the meaning of terms; but in general his distinctions are clear when his conceptions can be disentangled from their personal embodiment. The moral significance of his terms is to be taken into account along with their mental and physical meaning, as this moral meaning was to him their chief one.

The Mental Faculties. It seems probable that Langland's own ideas of the meaning of the various names for the mental faculties were derived from the passage translated, not altogether accurately, in Passus XVII., (B, XV., 23; C, XVII., 182). The character called Anima in B, Freewill in C, is defined according to its various functions as Anima (the vital principle) when it quickens the body; Animus (the reasoning principle or rational soul) when it will or would; Mens (the power of thought, the mind) when it understands or Knows; Memoria, when it recalls what has taken place ("makes moan to God"); Ratio, when it judges; Sensus, when it feels and perceives ("and that is wit and wisdom, the well of all crafts"); Conscientia, when it challenges (claims or excuses) or challenges not, bargains for or refuses (accepts or refuses); Amor, when it loves; Liberum arbitrium, when it will do or not do good deeds or ill (Lat.: turns from evil to the good); and Spiritus, when it flees from the body and leaves it lifeless. In the B-text all these terms except Free Will are given as names for Anima; but in the C-text they are given as names for Free Will, which is inserted and made to assume undue importance. The B-text is most consistent with the Latin original (Skeat, Notes, 215; C, XVII., 201), and with

the present accepted interpretation of the terms used. To say that this is a list of the specific functions or faculties of the soul is comprehensible; to say that the soul is a faculty of the will, and that the will is a faculty of itself, is to us nonsense.

Anima, or Life. **In this passage we should have a guide to the philo-**sophical interpretation of several important characters. Anima is mentioned elsewhere (C, XI., 127 ff.) as dwelling in a castle made of the four elements, earth, air, wind and water; she is dear to Kynde (interpreted as Nature, God) and is like Him. For safety she is placed in this castle whose lord is Dowel; his daughter Dobet is her servant; above both, peer of a bishop, is Dobest, her teacher, Inwit (Conscience) is constable of that castle; and with him are the other wits, his five sons, Seewell, Saywell, Hearwell, Workwell, and Goodfaith Gowell;—not exactly the five senses, but a conception of Langland's own of the agencies most likely to repel Satan.

The list of mental faculties given above is taken from Isidore (Skeat, Notes, 215). Following another source of popular philosophy, Langland says that Inwit is in the head and Anima in the heart. This statement is derived from Galen (Skeat, Notes, 140), who divides the functions into the vital, essential to life, whose seat is the heart; animal, perceived and subject to the will, whose seat is the head; natural, not perceived, whose seat is the liver. We are somewhat at a loss to determine whether Langland regards Anima as the vital function simply, common to men and other animals; or whether it is with him the more exalted if indefinable conception called the soul. The first passage seems to subordinate it unduly; the second is indecisive until we are told that it is like Kynde. Since Kynde undoubtedly means God in this case, possibly we here touch the higher conception.

Conscience. If conscience is an animal function, subject to the will, we are likely to land in confusion; but probably in making its seat the head Langland did not intend to follow Galen any farther. Rather he views conscience as an intellectual faculty under Divine direction. He has drawn a broad line of demarcation between Anima and Conscience, whatever his reason may have been; and again it seems as though to him Anima could be little more than physical life.

The character of Conscience as a moral teacher is one of the most consistently treated in the poem. Conscience is of the counsel of Truth, and cannot be deceived. Holy Writ is his guide upon doubtful points, but he insists upon a true interpretation. He is guided by Reason (C, V., 5) but is free to enlighten Reason before the latter

gives his decision (C, V., 33). Their respective functions would seem at first to be those of counselor and magistrate, but eventually Reason is appointed chancellor, and Conscience royal justice (C, V., 185), thus assigning them the same functions, but giving Reason the higher station. Again Reason is a pope, and Conscience bearer of his crosier (C, VI., 113). Thus Conscience seems to be made subject to the Bible, the Church and Reason.

Throughout the rest of the poem, Conscience is the personal adviser, guide and director of men, and leader of the forces of Holy Church. It is always therefore that enlightened intellectual faculty which judges and directs with regard to moral matters; appearing most often as the accuser and public prosecutor of Wrong.

Wit. We have next to distinguish Conscience or Inwit from Wit pure and simple. In Will's search for Dowel he follows a logically ascending scale of inquiry. First he meets Thought, and after receiving some information is directed to Wit; from Wit he passes to his wife, Study. Wit and Study should result in learning, and accordingly Study soon refers Langland to Clergy, whose wife, Scripture, (interpreted written knowledge) she has instructed (C, XI. and XII). Advancing in this line of intellectual development, Langland raises so many objections to some of the teachings received that he is finally accused of seeking knowledge only to cavil at it, and further knowledge is refused him. This is true in all the texts except A. In this (Passus XII) Scripture takes pity on Will, and directs him to her cousin, Kynde Wit; a proceeding that is apparently, in one sense, sending him back whence he started.

This sequence, with the exception of the fifth step of A, XII., which may be simply an inadvertence, becomes reasonably clear when examined by the light of the later definition of faculties. By comparing texts B and C, Thought is identified with *Mens* (C, XVII., 185; B, XV., 25), and Mens was defined as the mind, the fundamental power which underlies all mental action. The only reference to Wit here given is in the definition of Sensus as "whenne ich fele that folke telleth" and "that is witte and wisedome the welle of alle craftes." From this it appears that Wit means the mind as applied to the perception of truth, either mental or physical. Thought is the instrument, Wit its natural use. Wit applied to books becomes Study; the books are Scripture; the result of the application is Clergy.

What, then, is meant by Kynde Wit if it is not synonymous with Wit as already defined? The way to it is to be pointed out by the guide "Prove-all-things," until the seekers reach the burg, "Hold-fast-that-which-is-good." This seems to be the road to natural

wisdom, or common sense, as distinguished from clergy; the wisdom of experience; and probably this is the answer to the question.

Reason. Reason is defined as the faculty which may "deme domes and do as treuthe techeth" and this is in general consistent with the character as introduced through the poem. It is a righteous judge which interprets and applies law, particularly the law of God. In this capacity is its first appearance at the trial of Meed, and Conscience is accuser, also according to the formal definition. Reason, the preacher (C, VI., 114), interprets the law with reference to the pestilences, and the duty of men in relation thereto.

There is temporary confusion between reason and instinct when Langland wonders why reason gives to animals more assistance than to men; as though he really believed that animals could ponder and decide. But in reproving Langland for his questions (C, XIV., 196) Reason appears as judge; and even his silent departure with Piers Plowman from the dinner of Clergy, Conscience and the Doctor (C, XVI., 151) may be interpreted as a decision.

In summary, mind is that which receives knowledge; wit the channel through which knowledge comes, conscience the perception of it as right or wrong, reason the judge of its actual value, study is a second means used to obtain it (the first is wit or natural observation or perception); nature is one source of information, scripture another; the result from the first source of information is Kynde Wit, from the second, clergy.

Free Will. The greatest difficulty lies in interpreting Langland's conception of Free Will in the relation implied between Free Will and the other faculties. In the C-text Free Will is made the fundamental power, of which all the other faculties are manifestations; while in the B-text, Anima is the fundamental, and Free Will is not mentioned at all until we come to the description of the tree of Charity, which grows in a garden, the heart, in man's body; and Free Will is the farmer of that garden under Piers Plowman. In each text Free Will is the defender of the fruit of the tree against the Fiend; but in the C-text he acts in addition for a long time as preacher, teacher and guide. It is perhaps consistent to make Free Will a guide; but as to the other attributes here ascribed, it seems that Langland must be enlarging a certain part of his definition (that which will or will not do good deeds or evil, or that which turns from evil to the good) so as to make it cover the whole field of Conscience and Reason. In doing this he has lost sight of the distinctive function of the will, that of choosing, perhaps because he thinks that a choice involves the exercise of reason, conscience and the other faculties. In short it appears that he has come to a false conclusion with regard to the

nature of the will; and that the power he ascribes to it should really be ascribed to the soul, Anima; and we have here a further reason for supposing that with him the name Anima means simply vital action. This conception of Anima is consistent with so much of his Latin original as he gives in English; but in itself and in its relation to the will it is not consistent with the meaning of the passage as he gives it in Latin. I conclude that he may sometimes be at fault as to the meaning of terms, but that having taken his stand, whether upon a misconception or otherwise, he stands with reasonable firmness and is in general consistent with himself. And the clearest exposition of mental science in the fourteenth century was not likely to be particularly clear to one who approached the subject in a casual way, with the sole object of adding a new illustration to a popular treatment of an entirely different subject.

The Form of the Poem.

Visions. It has been said that a park and a vision constitute the stock mechanism of the literary compositions of the fourteenth century. Langland's method differs from the conventional method in that it makes more of the vision and less of the park than is usual. The whole work is a series of visions, and the moments of waking are so few and unimportant as scarcely to be noticeable. Where they are noticeable, they are often suggestive of the park, that is of the outer air, of the free life that the author must have lived at some early time; they breathe an atmosphere of the hills and woods, though even in this respect they produce an effect that is still conventional.

At other times the visions suggest what is not at all conventional: that the author's contemplative habits were productive of sluggishness. It seems strange that a person of his reverent habits should twice represent himself as going to sleep in church, unless such an occurrence was not altogether unknown in his actual experience; and we are reminded of Sloth who went to sleep during his own confession.

From another standpoint the structure of the poem as a series of visions is fortunate. Langland's work, regarded as a whole, lacks consistency; whether we take into account the central character or the minor ones; and even where he strove to secure consistency, we have seen that his success was not complete. But in a vision, entire consistency is not necessary; and in a series of them, the way is open for the author to follow his fancy whither he will, and to cast to the winds all the rules of unity and proportion and sequence; while we

still have no difficulty in gathering the specific lessons which Langland teaches in specific places.

Through the whole composition it is evident that the poem was really a growth, not a structure; or if a structure, put together in a childlike way; and the efforts to reduce it to structural beauty and proportion, while partly successful, were an afterthought.

Allegory. After the visions the allegories are the most prominent features, and here again Langland is following the example of others. But Langland carries his personifications farther than any other has done, except Bunyan; while he deals largely with the abstract and the ideal, he loves to make it as concrete and as tangible as possible.

Quotations. There is really more of originality and more of the spirit of the coming Reformation in his liberal use of quotations. His purpose was twofold; to show that his own teaching was in no sense revolutionary, but in accordance with the standard of the church; and to make the teaching of the church plain to all. To this latter end he translated the passages used, interpreted, commented, or preached from them as texts, and in a homely fashion that the simplest could understand. And while he could not place the Bible itself in the hands of the people, he did what he could toward that end, and approved the efforts of those who aimed to do more. Looking at the quotations simply, we might regard the whole poem as a series of sermons bearing upon daily duty as the chief topic, and even the metrical form and the imagery were well adapted to make the sermons effective; probably more so than Langland knew when he began to write.

Similes and Proverbs. The poem abounds in similes, proverbs, parables and puns, of which a fairly complete list is given in the index to Professor Skeat's edition. From Langland we may learn the origin of many expressions that are current in popular speech, if not in literature; as for instance, the supposedly profane expression "not worth a curse," proves to be the eminently fit and sensible remark, "not worth a cress" (C, XII., 14). Others especially striking are, "to have pepper in the nose" (B, XV., 197) for, to be angry; "measuring the mist on Malvern Hills" (C, I., 163) as preferable to meeting an attorney without money in hand; the familiar and mysterious saying, "as dead as a doornail" (C, II., 184), and the negative and ironical expressions, "as courteous as a hound in a kitchen" (B, V., 261), "as becometh a cow to hop in a cage" (R, III,, 262). These sayings and proverbs almost without exception wear the aspect of current coin of the realm, and add to the effectiveness of the pictures of common life.

Parables. Many of the parables are directly Scriptural. Of others one of the most pleasing and instructive is that of the merchant and the messenger (C, XIV., 33) which is probably Langland's own, and is no less significant literally than figuratively in regard to what may be called the laws of the road. Short but exceedingly happy is the friar's illustration of the wagging boat (C, XI., 32) by which it is conclusively shown how one may meet with many mishaps in religious life and yet be saved.

Puns. Plays upon words are not so numerous as might be expected. As good as any, though probably not original, are the comparison of *words* and *worts* (vegetables; B, V., 162), and that carried out at length (C, XVIII., 200) where the cross upon the reverse of the red noble is said to take the place of the cross of Christ in the worship of many.

The riddles, parables and puns illustrate rather Langland's close relation to the people than the peculiar character of his mind. Where the thought is more elevated they are fewer, but they sometimes occur where Langland is pressing most earnestly forward; and in such places they are evidently spontaneous and unstudied. This can hardly be said of such efforts as that to illustrate the difference between reward and bribery by the relations of grammar.

Structure of Allegory. The general structure of the allegory is as follows: First we have a picture of the world, which is given over to the lust for money and to the seven deadly sins. Those who realize the condition of affairs and long for a better estate are guided in their search for it by a humble plowman, until they learn that deliverance lies in Dowel. The author, as one of them, then begins a search for Dowel, Dobet and Dobest, as three stages of the way to holiness, and in the search meets various personages who question his motive, the road he is taking, his haste to reach the end of his journey. Each affords him all the help possible, but all are not in agreement. Finally attention is directed to Christ and His teaching as the culmination of Dowel, Dobet and Dobest; His crucifixion and resurrection are related; Conscience becomes the leader of His forces upon earth, and is sore besieged by Anti-Christ.

Allegorical Names. A minor point noticeable in Langland's method is the length of the names often bestowed upon persons and places. Piers Plowman's wife (C, X., 80) is "Work-when-time-is;" her daughter, "Do-right-so-or-thy-dam-shall-thee-beat;" her son, "Suffer-thy-sovereigns-have-their-will-, judge-them-not-, for-if-thou-do-thou-shalt-dearly-pay." In one instance (C, VII., 310) the name of a Welshman extends for several lines.

Obscurities. In its final form, the poem contains many obscurities due to various causes; some of them grammatical merely and due to carelessness or oversight. One passage seems faulty in every text (C, IV., 77-89, and parallels) because of the omission of the chief verb; but the fault in this case does not lead to obscurity. Lack of consistency in characterization is another source of difficulty; another seems due to sheer forgetfulness, as when the author goes to sleep on Malvern Hills and wakes up in London; in interpolating a passage he has neglected to ascertain what was the scene of the part into which it was interpolated. Lastly may be mentioned the riddles. What is intended as a puzzle may not be open to criticism because it is puzzling, but at least one of these is now inexplicable (B, XIII., 150-156; Skeat, Notes, 196) because of the impossibility of tracing the contemporary references. But Langland's puzzles and inconsistencies are not greater than those of Gower, who introduces into his work matters irrelevant or contradictory and illustrations that fit "as the fist does the eye" (Ten Brink, Eng. Lit., p. 135); and if Gower represents uninspired scholarship, Langland's humble inspiration without scholarship is preferable.

The Spirit of the Poem.

Influences Upon the Poem. Langland is distinguished from his great contemporaries as being of the priesthood and people, but not of the court; and this might be inferred from his language. Latin is used freely, while French appears but seldom, and French influence is slight, appearing about equally in language and subject matter. The growing lack of appreciation of French and the French people among the lower classes is clearly reflected, although Langland probably did not share in it himself. With regard to his subject, there was no other than a religious one for Langland with his narrower horizon when even Gower and Chaucer with their wider range of thought were constrained to treat it: Chaucer lightly and satirically, a touch here and there, Gower with all the intensity of which he was capable in the "Vox Clamantis." For Langland living in the fourteenth century and close to the hearts of the people as well as to their unhappy lives there was but one voice, the same voice of one crying in the wilderness, uttered in the language of the people. How far-reaching were the results of this utterance we may only infer from the popular uprisings that accompanied and the Reformation that followed it, though both uprisings and Reformation were led by others. Its poetic form was that usually chosen by those who had a message for the people not to be delivered from the pulpit; the form

which would ensure its sinking deep and circulating widely. And even in returning toward the Old English standard in the structure of his verse, Langland was not merely rejecting the newer French fashions; he was appealing still more directly to the popular sympathy.

Purpose. Langland, having convictions, believed it his duty to teach them to the people, and deliberately chose means to this end. His sole reference to his authorship of poetry, his "makynges" (B, XII., 15-29), speaks of it as recreation, resorted to that he may be more perfect in his more serious duties; and he quotes to his questioner, in justification, the examples of holy men. But this is merely deprecation. It occurs in the B-text, which must have been written after a conviction fully formed that this was the serious work of his life; and the holy fathers referred to were not in the habit of wasting even their moments of recreation in work that had no serious purpose. Langland felt that he must speak; and his first utterance was dictated by the desire to speak to the people as they spoke to each other, or as they were addressed by those who showed most power to interest them; and with this restriction, the Vision of Piers Plowman was, in its earlier form, a spontaneous outpouring.

Earnestness. Of its earnestness and depth of feeling with, as well as for, those in bondage to sin, harsh laws and a corrupt clergy, there can be no doubt. Scarcely another quality could be so profusely illustrated as this. Langland has his lighter moments as we shall see; but through all his purpose is distinct; and though he may cause others to smile, the smile is never reflected upon his own face. Through his pages, as through the streets of London, he strides, turning not to give place to any, making obeisance to none; we may laugh or we may tremble at his words, but while we laugh or tremble, he has passed on about the business whereto his Master sent him.

Insight. His practical insight, as distinguished from his philosophical insight, was great. He sees the good about him as well as the evil; there are worthy as well as criminal poor; there are charitable bishops as well as avaricious ones. But the good needs not the same emphasizing as the bad, and does not receive it. The causes of evil as well as the evil itself are apparent to him; he finds them not only in high places, but among the people themselves; not king and church only are responsible for lack of bread, but often the careless improvidence of the breadwinners. And if he does not suggest cures for all that needs cure, he points out a better road, a road that has since been followed, the way of Holy Writ; and most of all, he avoids the way of communism and anarchy, even though many thought they read of it in his work and some therefore ventured to walk in it.

The Prophecies. As to his insight into the future a question may fairly be raised. He believed it impossible to forecast, and yet has sometimes used the style of prophecy, though whether in earnest or in satire it is not always easy to say. One such passage (C, IV., 440-485) is rather a picture of what Langland hopes for than a prediction that it will take place. The picture bears a general resemblance to the millennium, and to show that it is distant he says that all Jews and Saracens shall first be converted. Another passage of similar character describes the time when Wrong may be pardoned (C, V., 108). Another (C, IX., 348-355) Professor Skeat believes to be merely a satire upon mysterious forms of prophecy then in vogue; it refers to a time of famine and pestilence when Death shall withdraw and Dearth be justice and Dawe the ditcher shall die for default (of food) unless God of His goodness grant us a truce. It contains an inexplicable riddle and a reference to the malign aspect of Saturn, and is almost too astrological to be seriously spoken.

But there is no doubt as to the seriousness of a passage which contains no riddles nor astrology (C, VI., 169):—

And yet shall come a king and confess you all
And beat you as the Bible telleth for breaking of your rule,
And amend you, monks, nuns, and canons,
And put you to your penance, *to return to your former state,**
And barons and their children blame you and reprove,
Some trust in chariots and some in horses. . . . They are brought down and fallen.
Friars in their refectory shall find at that time
Bread without begging to live by ever after,
And Constantine shall be their cook and coverer of their church:
For the Abbot of England, and the abbess his niece
Shall have a knock on their crowns, and incurable the wound;
The Lord hath broken the staff of the wicked, and the sceptre of the rulers . . . . with a continual stroke,
But before that king shall come as chronicles tell,
Clerks and holy church shall be clothed new.

Here, though Langland may show no prophetic insight, simply enunciating, as Professor Skeat says, an opinion generally current with reference to the power of the king, the expression must remain noteworthy, both for its power and dignity and for the manner in which it was fulfilled in the time of Henry VIII.

Independence and Courage. Langland's independence of opinion and judgment is attested in every line of his work. As to the proclaiming of his convictions, which must often have had to do with individuals as well as doctrines, his practice varies. Sometimes he hesitates to push his teaching to its logical conclusion, exclaiming that

* Italicised passages are in Latin in original.

he dares not (B, pr., 209), or that he that speaks most truly is soonest blamed; while again he challenges the acts of the bishop of Syria who looks like a real individual (C, XVIII., 278), impeach s the king himself (C, IV., 210), and fears not the death at the stake (B, XV., 81).

Conservatism. But the key to it all lies in his conservatism. It is not that he ever fears to speak because of any personal danger that may come to him; for religious persecution had not yet become severe, and he is most daring with regard to political matters where perhaps the danger of free speech was greatest, at least to those outside of the church. He hesitates to speak because he does not wish to disturb the established order, political or religious, but only to eradicate the abuses that have crept in; and if he should say all that he might, he might incite men to deeds that he does not approve, and be held responsible for a meaning and for results that he does not intend.

Imaginativeness and Originality. His imaginative faculty is fanciful rather than inventive, and is not strongly developed even in that direction. He sees facts and can depict them; he can reproduce pictures that others have painted, with slight variations of detail that serve to simplify rather than to elaborate; but in the domain of actual invention he is not at home. In his passages pertaining to Heaven and Hell, he leaves no actual picture in our minds, but simply enumerates the matters he wishes to bring before us. But in approaching nearer to things terrestrial the play of his fancy becomes greater and his work correspondingly more artistic.

Accordingly, his originality consists chiefly in the independence of view already mentioned, and in the vividness and power with which he treats of familiar matters, particularly those derived from his own experience. As to the actual subject matter, apart from his method of treatment, there is little or nothing not directly traceable to some outside source, except these facts of experience; and even his method is often borrowed. It is because of this that we learn that he had read some books, and seen some things that he never mentions directly. This is of course practically restating that his work shows fancy rather than imagination. The character called Imaginative shows less of imaginativeness than any other if that be possible, it is purely didactic; while many others are introduced with personal description.

Attitude toward Women. Langland's allusions to women are in proportion few, whether allegorical or real. The Lady Meed is first and most conspicuous; the female penitent representing Pride, Study, Scripture, Holy Church, Anima, and some minor characters practically complete the list. To these may be added a few references to his own wife and daughter, and to the women of London. His attitude toward the least of them is respectful; and in what he

says of Study and of his own wife he gives rise to the suspicion that in their presence he was humble as well as respectful. His feminine characters are no more puppets than are his masculine ones; he endows them with characteristics equally positive, we may say equally masculine; and from the lack of femininity we might infer either that Langland knew little of women, or that those he knew best were of an exceedingly positive type. In the familiar yet respectful leavetaking between Will and Scripture (A, XII., 38-48) we doubtless have the custom of the time.

Wit, Satire, Humor. The satire in Langland's work constitutes one of its strongest and most entertaining characteristics; naturally most often manifested in the attacks upon wrong, but in all its intensity never anything but kindly and wholesome. Usually the subject is treated in a manner too incisive to be called humorous; though always witty if we make the formal distinction (See Hunt, Eth. Teachings in O. E. Lit., p. 248); but the sense of humor is often present and sometimes becomes so prominent that the reader must smile, though he may never suspect the author of smiling. Of such a character is Meed's half-text (C, IV., 489) to which Conscience supplies the important remainder giving the true meaning; Avarice's interpretation of restitution to mean robbery (C, VIII., 234-238); the friar's ready claim that Dowel dwells with "ous freres" (C, XI., 18), and the knight's assistance of Piers against Wastour, which was so exceedingly "courteous as his kind would" as to be entirely ineffectual. Many descriptive passages are characterized by a sustained humor throughout, as the description of Sloth and Glutton; and the account of the doctor at dinner (C, XVI).

Descriptive Power. The portion of the poem which is most often referred to, the description of the field full of folk, is not so good from an artistic standpoint as many others; it is more interesting as illustrating the character of Langland's imagination and giving a hint at what the completed poem is to be. It is a catalogue rather than a picture; yet the field and the tower and the deep dale are so clearly defined that our imagination completes what Langland left unfinished; and the highest art could do no more. The proposed marriage and the trial of Lady Meed which follow are again less remarkable for accuracy than for force; the force due to earnestness of intention, and what may be termed massiveness of presentation, and the effect heightened by the striking transition from country to city.

But when we reach the confessions of the seven deadly sins, Langland's work cannot be surpassed for wit and for close accuracy of portraiture. The scenes already mentioned may have been founded

on events that came under Langland's observation but infrequently; a miracle play, a wedding on some country estate, a trial at Westminster; but now we are dealing with matters that touch his daily experience.

Only quotation can do justice to the personal descriptions here given; as for example that of Avarice, with his beetle-brows, thick lips, flabby cheeks, half-shaven chin, head twice covered with hood and with hat, and garment so threadbare as to be an unsafe promenade for insects. The account of the means by which Avarice made his money follows, and is so circumstantial as to prove beyond a doubt that Langland was speaking whereof he knew; and the length with which he dwells upon this topic shows it to be a favorite one.

The best character sketch of the entire poem is that which follows, the description of Glutton (C, VII., 350) at the tavern. Glutton may not be in his own person so much of a wit as the Sir John Falstaff to whom Professor Skeat compares him; but he shows many similar characteristics, and will serve well as the literary predecessor of Sir John. The glutton of Shakespeare's day was undoubtedly a more intellectual animal than the glutton of Langland's time. The account of the game of barter at the tavern (the Freimarkt), the subsequent fate of Glutton, and his tardy repentance give a most graphic and amusing picture of the common life of common people on its lighter side.

Of a different character, but still witty and diverting, is the account of Piers Plowman in the field and his efforts to make some use of several of the repentant sinners, who prove to be obstinate and unmanageable. Yet the author never relaxes for a moment, nor does he allow his reader to forget the terrible earnestness that underlies it all; and not the least charm of his wit and satire is its apparent unconsciousness.

We come to a picture of the darker side (C, X., 71), of the sufferings of the very poor, spoken no longer in satire but in the keenest pity, the pity of one who had perhaps himself known what it was to lack food and fire and covering:—

> Ruth is to read, or in ryme shew
> The woe of these women that dwell in cots,
> And of many other men that much woe suffer,
> Both a-hungered and a-thirst, yet turn the fair outward
> And are abashed to beg.

Moving as it is, we feel grateful to Langland for giving as an obverse to the tales of tricksters and cheats this picture of poverty, abject, but honest and self-respecting.

The account of the dress and habits of Haukyn is less striking than those mentioned, chiefly because of the more free introduction of

allegorical teaching. From this point on, the religious teaching becomes more and more prominent, and the descriptions carry with them a greater weight of meaning and become in this sense more impressive. Langland is not a Milton, yet he can rise to a certain simple sublimity of his own that is suggestive of Bunyan, if not of Milton. There is much in the mechanism of the poem that suggests Bunyan; as the account of the castle of Anima, and the adventures on the way to Kynd Wit (A, XII., 56). The author's dramatic power is shown in the account of the dinner of Conscience, Clergy and the Doctor with Reason; even the Latin is not without its effect here, though the appearance of Piers Plowman is forced and unnecessary. Of the remaining portions, the most noteworthy from our present point of view are the account of the crucifixion (C, XX), the conquering of Hell (C, XXI), the building of Piers' barn (C, XXII), and in fact the whole of the last passus, which shows more of originality if not more of power than the account of the harrowing of hell.

In summary Langland's descriptive power is noticeable, as might be expected, in those things with which he was most familiar,—scenes of common life in city or country, and the things in which he was most deeply interested,—the passion and mission of Christ. Of actual invention there is little; and his power, while unquestionable, is not due to any attempt at art, but is incident to the directness and earnestness of his purpose. As examples of his most artistic work at its two extremes, I prefer the description of Glutton and that of the siege of Holy Church in the last passus, because in both the author himself is distinctly present, and the two most opposite sides of his character are clearly revealed: his brightest humor and his deepest sadness.

Scholarship. Touching the question of Langland's education and scholarship (See p. 234, and Ten Brink, Early Eng. Lit., p. 352) the list of Langland's positive attainments includes, besides English Grammar and English Law, Latin, and something of French; but nothing at all of Greek. He had access to a few books only, and beyond that source his knowledge was for the most part that which was common property among thinking men.

I find the total number of distinct quotations in the poem to be about 475. Of these, 368 are directly from the Vulgate, and 29 more are probably from the same source, but are inexactly given. Of the remaining 75, 11 are from the services of the church, 5 from Latin hymns, 5 from the Legenda Aurea of Jacobus de Voragine, 18 from the church fathers, Augustine, Jerome, and Gregory, and other church writers; 9 from the Disticha de Moribus ad Filium of Dion-

ysius Cato, 3 from the Historia Scholastica of Peter Comestor, 2 and perhaps more from the Compendium of Peter Cantor; and one each from Boethius, Vincent of Beauvais, Juvenal, and others; besides several which Professor Skeat has been unable to trace, three or four of them in French in leonine verse, perhaps of Langland's composition. In addition there are a very large number of general allusions to these and other literary sources (See Piers Plowman, E. E. T. S. edition, Vol. IV., Section I., p. 512). Many of Langland's direct references to authorities are inexact, and he often gives the sense of authors quoted rather than their exact words, showing that reference to originals was not always easy; while the fewness of the errors in the references to the Vulgate speaks well for the power of his memory. It is probable that the list given comprises more works than were actually in Langland's reach, and that he knew most of the authors he cites from some collection of extracts. Especially do his references to the classics wear an aspect of being second hand.

Besides the few bits of French verse which may have been composed by Langland himself, there are several allusions and several resemblances of structure or action which suggest a knowledge of French works; especially Grosteste's "Chastel d'Amour," which may have been read in English translation, Huon de Meri's "Tornoiment de l'Antichrist," and Rutebuef's "La Voie de Paradis." Further, in many instances the scene and action of the poem show conclusively that Langland was familiar with the stage representations of religious mysteries.

His references to Greek authors are undoubtedly conventional or second hand (Plato, C, XII., 304; Aristotle, C, XV., 184). He mistranslates the name of Christ (C, XXII., 15), again misled by convention; and there was noticed an instance of departure from the exact meaning of a Latin original (Page 272). Occasionally he seems to have turned an ordinary saying into Latin on his own account, as if to give it greater weight.

From the preceding it seems that we may draw one new conclusion; that if these references and citations indicate the full scope of Langland's reading and literary training, his poetic faculty must certainly have been an inborn one. It is of course probable that he was familiar with English poetical versions of the legends and stories of which he makes continual use, as well as with popular versions of parts of the Scripture narrative, such as the Cursor Mundi, and the Miracle Plays. But the fact that he does not quote from these would indicate that he has received from them no distinct impression of poetical form, while the character of his versification and imagery and his return to alliteration furnish stronger evidence toward the

same point. The church fathers could never have made Langland a poet; but a reflective habit and a sympathetic and earnest disposition aided by a ready ear, a quick wit, a retentive memory, and the study of men as well as of books, could and did.

His legal learning was extensive, appearing in the form of copious allusions to facts of law so exact as to indicate more than common familiarity. Many of these are of a character to be picked up easily by attendance at courts; others, such as the knowledge of legal forms, imply some study and practice. Perhaps he was more than a looker on at Westminister; at least he must have attended there, probably for the purpose of acquiring knowledge that would be of practical use outside, as well as a knowledge of human nature; and had any occupation offered itself there, he would doubtless have seized upon it and turned it to good account.

As to the source of Langland's literary and religious traiuing, I find that in my own mind, in the light of the preceding investigation, opinion has deepened into positiveness that he never saw the inside of university walls, scarcely even as a casual visitor. The list just given of his positive attainments would not of itself afford satisfactory evidence on either side; what he knew he might have learned within a university, though a student as earnest and conscientious as Langland should it seems have learned more and learned it more systematically. And even if university training was not so systematic in Langland's time as it has since become, there is still nothing in Langland's stock of knowledge which he could not have gained in the ordinary monastic schools and from contact with men.

But the strongest argument is that there is nowhere in either text the slightest reference to any university, or the slightest reflection of university life. The scene of the poem taken as a whole does reflect, unless with this exception, all the life that Langland had presumably lived; there are the fields and hills and streams of his boyhood days, and there are the crowded streets and questionable tavern society of London, the greedy crowd of the law court, and the reverent throng at the church. There is ample support for the common theory as to Langland's connection with the church and his position in it. If therefore we find all this reflected even to detail, and know that to Langland the place of study was a heaven upon earth, I cannot escape the conclusion that even a brief experience of university life would have so impressed itself upon his mind that we should have evidence of it again and again. Not finding this evidence I conclude that Langland's education, after a comparatively early age, was due to his own unaided efforts. A self taught man might easily feel the pride in a little knowledge of grammar and of French that he allows

himself to show; yet a diligent man among such associations as his might learn all that he knew. That he did develop himself so fully in despite of difficulties, causes us to honor yet more highly the humble student who was greater than any learned doctor of his time, save one alone.

The Value of the Poem.

Past Influence, and present estimate.

The influence of the Vision concerning Piers the Plowman in helping to bring about a political upheaval that pointed the way to a religious revolution is historical and needs no restatement. Wyclif quoted from Langland, and both Langland and Wyclif were misinterpreted by many wrong headed ones whose efforts to hasten the coming of Langland's mil lennium, when "shall neither king nor knight, constable nor magistrate, overburden the commons," materially retarded its advance. Thus the greatest immediate influence of the work was in a direction that its author neither contemplated nor desired; but though centuries were needed for the accomplishment of its true purpose and that accomplishment involved more than the dreamer dreamed, we may feel that Piers Plowman did return to Holy Church and that the work of Langland was the first step toward his returning.

To us the work is of immeasurable value as a storehouse of information; and the feeling of each student of it must be that a lifetime is scarcely sufficient for the full interpretation of a work upon the mere text of which one scholar has already expended half a lifetime.

Restoration of Aceratherium fossiger Cope.

BY S. W. WILLISTON.

(With Plate VIII.)

As is well known, the larger part of western Kansas is overlaid by a freshwater deposit lying unconformably upon the Cretaceous. This deposit had been traced as far east as Wichita, and, by Professor Hay, in isolated patches to Junction City. As has been shown by both Professor Hay and myself, the topography of the western part of the state had become essentially that of the present day before its deposition. Its c.ief characteristic is a bed of coarse sandstone, often filled with large, water-worn pebbles, whose origin was of course the Rocky Mountains. This stone, however, varies greatly in different places; sometimes composed largely of lime, and even furnishing a serviceable limestone for building purposes; in other places it is more sandy or may be a loose sand. The "natural lime," a pulverulent carbonate of lime, with some sand, used in various places for building, is from the same deposit. In general, however, the deposit is best characterized by the name commonly given to it of "mortar beds." These "mortar beds" are everywhere found underlying the extensive tablelands of the plains, a fact easily demonstrable by the wells, which, almost invariably penetrate to the lowermost parts overlying the impervious shales of the Cretaceous, at a depth, on the level plains of from one hundred to one hundred and twenty-five feet.

The lower portion of the deposit is the Loup Fork Tertiary; the upper the Pliocene, but just how much belongs to each is at present uncertain. A recent find of characteristic Pliocene mammals about one hundred feet above the chalk in Sherman county leaves no question of the age of the uppermost deposits. In the coarser and harder sandstone of the Loup Fork beds, the prevailing vertebrates are the larger Testudos; in the looser sand, either of the same age or a little older, occur most frequently the various mammalian remains which have been discovered in such abundance and in widely remote localities. Of these remains those met with by far the most frequently pertain to two or more species of Rhinoceros, which have been found in different localities from the extreme south to the extreme north of the state as well as in Nebraska. Of these, *Aceratherium fossiger* is the only one commonly met with.

By far the most productive of any of the known localities is that in Phillips county a few miles south of Long Island, a locality which has already yielded vast quantities of bones, and which is in nowise exhausted. The localitiy was first discovered in 1883 by Mr. Charles Sternberg, who that year collected from it for the University of Kansas. In the two following years, Mr. Sternberg and Mr. J. B. Hatcher obtained large numbers of bones from the same spot for the United States' Geological Survey, under the direction of Professor Marsh, who renamed most of the species found there. Later, collections were made from this same locality by Professor Cragin, and, in 1891, by the late Mr. E. P. West, of the University of Kansas. From the large collections made by him and Mr. T. R. Overton, on whose father's farm the "bone-quarry" is located, the skeleton, a photograph of which is shown in Plate VIII, was obtained. Mr. Overton has been, since the death of Mr. West, my assistant in the Museum of Kansas University, and the restoration is chiefly due to his skillful and careful labor. It is very rare that any two bones are found in relation in this especial deposit, so that the discovery of a skeleton at all complete of any individual is extremely improbable. The skeleton as restored is, therefore, a "composite," made up, probably, of nearly as many individuals as there are bones. Nevertheless, so well are the bones articulated, one would hardly suspect that they had not belonged to a single individual. The different elements of the skeleton were selected from among many hundreds of this species. In the preparation of the skeleton, I have constantly advised with Mr. Overton, and I am under obligations to Prof. Henry Osborn of Columbia, who at his visit to the University the past year, made a number of suggestions and criticisms, which have been followed so far as possible. The bones themselves, in their natural state are far too soft to admit of articulation. They were, therefore, saturated with hard paraffine, of which nearly fifty pounds were used.

The principal dimensions of this skeleton are as follows: Length, not including tail, 9 feet; height, 4 feet; greatest girth, 9 feet 4 inches.



RESTORATION OF ACERATHERIUM FOSSIGER COPE.
One-sixteenth natural size.

PROSPECTUS.

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